Supreme Court, U.S.
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No.

IN THE

Supreme Court of the United States

JBL, INC. AND INFINITY SYSTEMS CORPORATION,
Petitioners,

v.

BOSE CORPORATION,
Respondent.

On Petition for Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

PETITION FOR WRIT OF CERTIORARI

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QUESTION PRESENTED

Prosecution history estoppel restricts application of the doctrine of equivalents when a patent claim limitation was narrowed by amendment to overcome a prior art rejection. This Court unanimously affirmed the doctrine of prosecution history estoppel in both *Festo* and *Warner-Jenkinson*.

This petition raises an important question of federal law, which the Federal Circuit has answered squarely in conflict with decisions of this Court:

Does prosecution history estoppel apply to a limitation in an issued patent claim when that claim replaced one in which the patentee amended the same limitation to overcome prior art rejections?

PARTIES TO THE PROCEEDING

Petitioners, JBL, Inc. and Infinity Systems Corporation, are wholly owned by Harman Investment Company, Inc., a Delaware corporation that is wholly owned by Harman International Industries, Incorporated.

There are no subsidiaries or affiliates of JBL, Inc. or Infinity Systems Corporation that have issued shares to the public.

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JBL, Inc. and Infinity Systems Corporation (collectively, "JBL"), hereby petition for a writ of *certiorari* to review the judgment of the United States Court of Appeals for the Federal Circuit in this case.

OPINIONS BELOW

The opinion of the court of appeals (Pet. App. 1a to 10a)[1] is reported at 274 F.3d 1354 and at 61 U.S.P.Q.2d 1216. The August 31, 2000, opinion of the district court (Pet. App. 11a to 75a) is reported at 112 F. Supp. 2d 138. The April 14, 2000, opinion of the district court (Pet. App. 76a to 105a) is reported at 98 F. Supp. 2d 80 and at 55 U.S.P.Q.2d 1329.

JURISDICTION

The court of appeals rendered its judgment and opinion on December 17, 2001. On January 31, 2002, the court issued an order denying JBL's timely combined petition for rehearing and rehearing en banc. (Pet. App. 106a to 107a). This Court has jurisdiction under 28 U.S.C. § 1254(1).

CONSTITUTIONAL AND STATUTORY PROVISIONS INVOLVED

Article 1, section 8, clause 8 of the Constitution provides:

"Congress shall have the power . . . to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their Respective Writings and Discoveries."

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[1] References to Pet. App. __ are to the appendix found at the close of this petition.

35 U.S.C. § 271(a) provides:

"Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes the patent."

STATEMENT OF THE CASE

Respondent, Bose Corporation ("Bose"), brought this action against petitioner, JBL, for alleged infringement of U.S. Patent No. 5,714,721 ("the '721 patent"). The '721 patent is directed to a loudspeaker port. The single independent claim of the '721 patent requires that the loudspeaker port have an elliptical shape. This port-shape limitation was the focus of attention during prosecution of the patent application before the U.S. Patent and Trademark Office ("PTO"). Facing rejections based on prior art loudspeakers with similar port shapes, Bose progressively narrowed the scope of its port shape limitation by amendment five times before settling for an elliptical shape.

The district court granted summary judgment that JBL's accused loudspeaker ports do not literally infringe the '721 patent. However, the district court ultimately found infringement under the doctrine of equivalents. Despite Bose's five narrowing amendments to the port-shape limitation, the district court held that prosecution history estoppel did not prevent Bose from relying on the doctrine of equivalents. The Federal Circuit affirmed the district court's judgment without even addressing the five narrowing amendments.

By allowing application of the doctrine of equivalents in this case, the district court and the Federal Circuit created a loophole through which any patentee can avoid the effects of prosecution history estoppel and recapture claim scope that was surrendered by a narrowing amendment. According to the decision in this case, such recapture may be accomplished merely by canceling the rejected claim at issue and rewriting in independent form a dependent claim already having the narrower limitation.

I. THE PROSECUTION HISTORY OF THE '721 PATENT

On February 27, 1992, Bose filed its loudspeaker port patent application as a "continuation-in-part" ("C-I-P") of a previous application. Original claim 1 of the C-I-P application read as follows:

> A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure *having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume.*

(Pet. App. 78a, 102a) (red coloring and emphasis added). Original claim 2 of the C-I-P application depended upon claim 1 and included the additional limitation, "wherein said port defines a boundary between the acoustic mass therein and said inside volume, *said boundary being defined by an ellipse.*" (Pet. App. 79a) (red coloring and emphasis added).

The loudspeaker shown in Figure 1 of the '721 patent is reproduced below with red coloring to highlight the elliptical port-shape at issue.

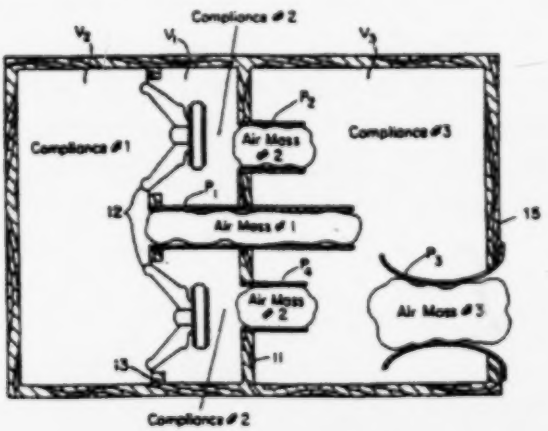

FIG. 1

The PTO rejected original claim 1 under 35 U.S.C. § 102(b) because two prior art references anticipated the claimed port shape. In response, Bose offered the first of five narrowing amendments (Amendment A) to claim 1. (Pet. App. 79a, 102a). The PTO again rejected claim 1 based on the same two prior art references. After an unsuccessful appeal, Bose narrowed claim one by amendment for the second time (Amendment C). (Pet. App. 79a, 102a).

The PTO then rejected claim 1 under 35 U.S.C. § 102(e) based on a newly-discovered prior art reference. In response to the new rejection, Bose further narrowed the port-shape limitation of claim 1 by amendment (Amendment D). (Pet. App. 80a, 103a). Faced with repeated rejections from the PTO based on the same reference, Bose narrowed the same port-shape limitation twice more (Amendments E and F). (Pet. App. 81a-82a, 103a-104a).[2]

With the difference between original claims 1 and 2 dwindling, Bose narrowed the port-shape limitation for the sixth time by canceling claim 1 and rewriting claim 2, including the elliptical port-shape limitation, in independent form. (Pet. App. 82a). Bose then added one further limitation to claim 2, requiring an ellipse "having a major diameter," in response to a rejection under 35 U.S.C. § 112, ¶ 2. Having narrowed the claimed port-shape limitation to cover only an ellipse, Bose finally secured allowance of the '721 patent from the PTO.

II. THE PROCEEDINGS BELOW

Bose sued JBL for infringement of the '721 patent. JBL filed a motion for summary judgment of non-

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[2] The district court summarized all five of Bose's amendments to claim 1 in an exhibit to its April 14, 2000 opinion (Pet. App. 102a-104a).

infringement. Shortly before trial, the district court granted JBL's motion on the issue of literal non-infringement because the ports of JBL's accused products were not elliptical in shape. (Pet. App. 78a, 87a). The court identified questions of material fact, however, regarding infringement under the doctrine of equivalents, and deferred that issue for the trial. In doing so, the district court decided that prosecution history estoppel did not preclude Bose from asserting the doctrine of equivalents in the first place. The court explained that, "In sum, Bose's arguments to the Examiner do not show a 'clear and unmistakable surrender' of subject matter encompassing JBL's port tubes." (Pet. App. 96a).

After a bench trial, the district court found infringement under the doctrine of equivalents. (Pet. App. 25a-30a). The district court entered a permanent injunction prohibiting sales of the accused products, and subsequently entered three judgments for money damages totaling $7,641,900.84.[3]

On appeal, the Federal Circuit affirmed the district court's decisions. In its opinion, the Federal Circuit explained that Bose was entitled to equivalent claim scope because it had not narrowed original claim 2 during prosecution. (Pet. App. 5a-7a). To reach this conclusion, the court considered only the final amendment Bose made in response to the § 112 rejection. The Federal Circuit did not consider the five narrowing amendments Bose made to original claim 1 before canceling that claim. Nor did the Federal Circuit address the effect of canceling original

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[3] The district court entered the original judgment in the amount of $5,676,718.32 on September 12, 2000 (Pet. App. 108a). The court subsequently entered a corrective judgment in the amount of $1,769,601.18 on October 25, 2000. On February 26, 2001, the court entered a supplemental judgment in the amount of $195,581.34 for royalties on certain authorized post-judgment sales.

claim 1 and rewriting original claim 2, with its narrower elliptical port-shape limitation, in independent form.

On January 31, 2002, the Federal Circuit denied JBL's combined petition for rehearing and rehearing *en banc*. (Pet. App. 106a-107a).

REASONS FOR GRANTING THE WRIT

Petitioners seek review because (1) the decision in this case is in direct conflict with this Court's decisions in *Festo* and *Warner-Jenkinson*; (2) the decision is erroneous; and (3) the question presented is critically important to preservation of the balance between the doctrine of equivalents and the public notice function of the prosecution history.

I. THE DECISION IN THIS CASE CONFLICTS SQUARELY WITH THIS COURT'S DECISIONS IN *FESTO* AND *WARNER-JENKINSON*

After Bose affirmatively and explicitly surrendered claim scope to overcome prior art rejections during prosecution, the district court and the Federal Circuit allowed Bose to recapture that claim scope in this infringement action. The decision in this case ignores the standards of prosecution history estoppel set forth in *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17 (1997), and, more recently, in *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, --- U.S. --- (2002).

A. The Conflict With *Festo*

The parties do not dispute that JBL's accused devices would fall within the scope of claim 1 *as originally filed* in Bose's C-I-P application. However, through the gradual narrowing of original claim 1, and the ultimate cancellation of that claim in favor of the narrower elliptical port-shape limitation of original claim 2, Bose

removed JBL's accused devices from the literal scope of its claim. As the district court correctly found, JBL's accused devices do not literally infringe the claims that ultimately issued in the '721 patent. (Pet. App. 78a, 87a.) Accordingly, JBL's accused devices fall squarely into the territory that Bose surrendered during prosecution. This is precisely the situation in which prosecution history estoppel applies, as the Court explained in *Festo*:

> When, however, the patentee originally claimed the subject matter alleged to infringe but then narrowed the claim in response to a rejection, he may not argue that the surrendered territory comprised unforeseen subject matter that should be deemed equivalent to the literal claims of the issued patent. On the contrary, '[b]y the amendment [the patentee] recognized and emphasized the difference between the two phrases[,] . . . and [t]he difference which [the patentee] thus disclaimed must be regarded as material.'

Festo, slip op. at 8 (quoting *Exhibit Supply Co. v. Ace Patents Corp.*, 315 U.S. 126, 136-37 (1942)).

Festo established that, when a patentee narrows a claim by amendment, the patentee is presumed to have surrendered the territory between the original claim and the amended claim. *Id.* at 15. The patentee bears the burden of showing that the amendment did not surrender the particular equivalent in question. *Id.* The patentee may satisfy this burden by showing that, at the time of the amendment, one skilled in the art could not reasonably have been expected to draft a claim that would have literally encompassed the alleged equivalent. *Id.* at 16.

The presumption in this case is that Bose surrendered coverage, including the territory between original claim 1

and claim 2 as amended to include the elliptical port shape. JBL's accused devices fall within that surrendered territory because they were literally covered by original claim 1, but not by amended claim 2. Moreover, Bose did not meet its burden of showing that the equivalents in question were not surrendered. If Bose believed that it was entitled to broader coverage, it should have used readily available language to describe other types of port shapes. Instead, after repeatedly narrowing its claims in response to prior art rejections, Bose ultimately settled on language describing only one specific port shape—an ellipse. Because Bose repeatedly narrowed the port-shape limitation and acquiesced on appeal to the Board of Patent Appeals and Interferences, Festo teaches that Bose surrendered coverage of the matter removed by amendment.

Bose should not now be allowed to recapture equivalents that it surrendered by amendment. Yet, the Federal Circuit's decision allows just that. Neither the district court nor the Federal Circuit imposed a presumption that estoppel applies, even though Bose had surrendered the territory between the original claim and the amended claim. In fact, the Federal Circuit's opinion is silent with respect to the five narrowing amendments that Bose made to original claim 1 and the cancellation of that claim in favor of the narrower original claim 2.

In addition, neither the district court nor the Federal Circuit required Bose to show that it had not surrendered the equivalents in question. Indeed, Bose made no such showing. Nevertheless, both the district court and the Federal Circuit permitted application of the doctrine of equivalents to JBL's accused devices regardless of the narrowing amendments. The decision in this case conflicts squarely with *Festo*, and the Court should grant *certiorari* to resolve the conflict.

B. The Conflict With *Warner-Jenkinson*

Festo represented a clarification of, rather than a departure from, the rule set forth in *Warner-Jenkinson* and other previous cases addressing the doctrine of equivalents. Accordingly, the decision in this case is contrary to *Warner-Jenkinson* for essentially the same reasons that it is contrary to *Festo*. Nevertheless, one particular aspect of the *Warner-Jenkinson* decision elucidates the error in the present decision below.

In *Warner-Jenkinson*, the Court reaffirmed the vitality of both the doctrine of equivalents and its limitation by prosecution history estoppel. The Court established that application of prosecution history estoppel depends upon the reason for which an amendment was made. *Warner-Jenkinson*, 520 U.S. at 33-34. In particular, prosecution history estoppel applies when an amendment was made for a substantial reason related to patentability. *Id.*

Bose made all five of the narrowing amendments in this case to overcome prior art rejections under 35 U.S.C. § 102. Likewise, Bose narrowed the scope of the port-shape limitation a sixth time in response to a § 102 rejection when it canceled original claim 1 and rewrote original claim 2, including the narrower elliptical port-shape limitation, in independent form. In each of these six cases, a substantial reason related to patentability motivated Bose—namely, narrowing the claims to overcome a prior art rejection under § 102. Accordingly, Bose should have been estopped from claiming a range of equivalents to the elliptical port-shape limitation that recaptured the surrendered claim scope. The Federal Circuit's decision to allow Bose a range of equivalents that included JBL's accused devices, therefore, is contrary to *Warner-Jenkinson*, and *certiorari* should be granted to correct the decision.

II. THE DECISION IN THIS CASE IS ERRONEOUS

The Federal Circuit's decision conflicts not only with *Festo* and *Warner-Jenkinson*, but also with numerous other cases previously decided by this Court and by the Federal Circuit. *See, e.g., Exhibit Supply*, 315 U.S. at 136-137; *Diversitech Corp. v. Century Steps, Inc.*, 850 F.2d 675, 681 (Fed. Cir. 1988) (when claims covering the accused device were rejected on appeal and cancelled, the surrendered claim scope may not be recovered by applying the doctrine of equivalents to another claim).

Bose was allowed to recapture in court a range of equivalents that it had affirmatively and explicitly surrendered before the PTO. Moreover, the Federal Circuit did not even address the five narrowing amendments Bose made during prosecution, nor the effect of Bose's decision to cancel original claim 1 and rewrite original claim 2 in independent form. Instead, the court of appeals erroneously considered only the single amendment made directly to original claim 2 in response to a § 112 rejection, and found that single amendment not to be narrowing. Accordingly, the decision below is contrary to law established by both this Court and by the Federal Circuit. *Certiorari* should be granted to correct this error.

III. THE QUESTION PRESENTED IS CRITICALLY IMPORTANT TO BOTH EXISTING AND FUTURE PATENTS

This Court in *Festo* clarified the boundaries of prosecution history estoppel and the doctrine of equivalents. The relationship between these two doctrines affects the scope of virtually every patent in existence, and, more important, every patent that will issue in the future. The decision in the instant case, however,

undermines the clarity that this Court established in *Festo* by creating a loophole through which a patentee may recapture subject matter that it previously surrendered. If the Federal Circuit intended to create this exception to the rule of prosecution history estoppel, it is an exception that will quickly outgrow the rule.

According to the decision in this case, a patentee who has surrendered equivalents of an independent claim may recapture those equivalents by canceling the independent claim and rewriting a similar dependent claim in independent form. If this decision is allowed to stand, it undoubtedly will be exploited by patent applicants, and the delicate balance struck in *Festo* and *Warner-Jenkinson* between patentees and the public will be destroyed.

The public is entitled to notice of a patent's scope. As the Court recognized in *Warner-Jenkinson*, "There can be no denying that the doctrine of equivalents, when applied broadly, conflicts with the definitional and public-notice functions of the statutory claiming requirement." *Warner-Jenkinson*, 520 U.S. at 29. Allowing a patent applicant to illegitimately enlarge the substantive scope of his claims through a procedural technicality undermines the public's ability to determine the legitimate scope of the patent. The Federal Circuit's decision to ignore the amendments made to original claim 1 creates just such a procedural technicality. Accordingly, to preserve the proper public notice of claim scope, the Court should grant *certiorari* to correct this decision consistent with *Festo* and *Warner-Jenkinson*.

CONCLUSION

For the reasons set forth above, the petition should be granted so that the Court may consider the effects of this procedural loophole, which is contrary to binding precedent. Alternatively, the Court should vacate the decision below and remand this case to the Federal Circuit for proceedings consistent with the Court's decisions in *Festo* and *Warner-Jenkinson*.

Respectfully submitted,

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APPENDIX

In the
United States Court of Appeals
for the Federal Circuit

Appeal No. 01-1054

BOSE CORPORATION,

Plaintiff-Appellee,

v.

JBL, INC. and INFINITY SYSTEMS CORPORATION,

Defendants-Appellants.

Appeal from the United States District Court
for the District of Massachussetts.
No. 98-10209–Patti B. Saris, *District Judge*.

Decided December 17, 2001

Before MAYER, *Chief Judge*, NEWMAN and BRYSON, *Circuit Judges*.

MAYER, *Chief Judge*. JBL, Inc. and Infinity Systems Corporation (collectively "JBL") appeal the orders and judgments of the United States District Court for the District of Massachusetts: (1) denying JBL's motion for summary judgment of invalidity of U.S. Patent No. 5,714,721 ("'721 patent") directed to "Porting," *Bose Corp. v. JBL, Inc.*, No. 98-10209-PBS (D. Mass. August 14, 2000) (memorandum and order); (2) denying JBL's motion for summary judgment of non-infringement of the '721 patent, id.; (3) ordering judgment for Bose and awarding damages, id. (August 31, 2000) (memorandum and order); and (4) entering judgment for Bose in the amount of

$5,676,718.32, id. (September 12, 2000) (judgment). We affirm.

BACKGROUND

Bose is the owner of the '721 patent, relating to porting in a loudspeaker system covering an invention of Brian Gawronski and Gerald Caron, both Bose employees. The '721 patent is a continuation of U.S. Application Serial No. 843,858 (abandoned), which is a continuation-in-part of U.S. Application Serial No. 621,531, that matured into U.S. Patent No. 5,092,424 ("Schreiber patent"). "Porting" pertains to a port tube inside a loudspeaker enclosure used to radiate acoustic energy from inside the loudspeaker enclosure to an area outside the loudspeaker enclosure at high, crisp audible levels. The design of the port tube is critical in avoiding audible distortion. The specific feature at issue here is the shape of the boundary surrounding the port tube.

The '721 patent consists of six claims: independent claim 1 and dependent claims 2-6. Claims 1-3 are most relevant and read as follows:

1. A loudspeaker enclosure with at least one port for radiating acoustic energy to a region outside said enclosure and having an inside volume,

   said at least one port having an axis and characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume,

   wherein said port defines a boundary between the acoustic mass therein and said inside volume,

said boundary being defined by an ellipse having a major diameter.

2. A loudspeaker enclosure in accordance with claim 1 wherein said boundary is defined by the rotation of said ellipse about the axis of said port.

A loudspeaker enclosure in accordance with claim 2 wherein the length of said port corresponds to the major diameter of said ellipse.

'721 patent, col. 2, ll. 33-51 (emphasis added).

Bose's application, which matured into the '721 patent contained nine claims as originally filed: independent claim 1 and dependent claims 2-9. Four of these original claims are relevant to the issue before us:

1. A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a flared input end within said inside volume and a flared output end adjacent to the region outside said inside volume.

2. A loudspeaker enclosure in accordance with claim 1 wherein said port defines a boundary between the acoustic mass therein and said inside volume, said boundary being defined by an ellipse.

3. A loudspeaker enclosure in accordance with claim 2 wherein said boundary is defined by the rotation of an ellipse about the axis of said port.

4. A loudspeaker enclosure in accordance with claim 3 wherein the length of said port

> corresponds substantially to the major diameter of said ellipse.

U.S. Application Serial No. 843,858.

Bose brought suit for patent infringement against JBL claiming that its loudspeaker enclosures using the "Linear-A" curve or the "Exponential" curve included the port technology of the '721 patent. JBL asserted non-infringement and the affirmative defense of invalidity. JBL moved for summary judgment of non-infringement, both literal and under the doctrine of equivalents, for speaker models N24, N26, N28, N38, ND310, S26, S38, S312, SCS125, ESC300B, and ESC350. The district court granted JBL summary judgment of non-infringement with respect to literal infringement, but denied its motion for summary judgment under the doctrine of equivalents. After a bench trial, the court entered judgment for Bose and awarded damages of $5,676,718.32. This appeal followed.

JBL advances three primary arguments on appeal: the district court (1) erred in denying summary judgment of non-infringement under the doctrine of equivalents; (2) abused its discretion by excluding evidence; and (3) erred in determining the applicable royalty base. We address each in turn.

DISCUSSION

"We review a district court's grant of summary judgment *de novo*." *Vanmoor v. Wal-Mart Stores, Inc.*, 201 F.3d 1363, 1365, 53 USPQ2d 1377, 1378 (Fed. Cir. 2000) (citing *Petrolite Corp. v. Baker Hughes, Inc.*, 96 F.3d 1423, 1425, 40 USPQ2d 1202, 1203 (Fed. Cir. 1996)). "Summary judgment is appropriate when there is no genuine issue as to any material fact and the moving party is entitled to judgment as a matter of law." *Id.* Summary judgment is improper "if the evidence is such that a reasonable jury

could return a verdict for the nonmoving party." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248 (1986). When ruling on a motion for summary judgment, all of the nonmovant's evidence is to be credited, and all justifiable inferences are to be drawn in the nonmovant's favor. Id. at 255. Prosecution history estoppel is a legal question subject to our *de novo* review. *Cybor Corp. v. FAS Techs., Inc.*, 138 F.3d 1448, 1459-60, 46 USPQ2d 1169, 1177-78 (Fed. Cir. 1998) (*en banc*).

An accused device that does not literally infringe a claim may still infringe under the doctrine of equivalents if each limitation of the claim is met in the accused device either literally or equivalently. *See Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 40 (1997). "Prosecution history estoppel serves to limit the doctrine of equivalents by denying equivalency to a claim limitation whose scope was narrowed during prosecution for reasons related to patentability." *Pioneer Magnetics, Inc. v. Micro Linear Co.*, 238 F.3d 1341, 1344, 57 USPQ2d 1553, 1555 (Fed. Cir. 2001).

To decide whether a claim amendment gives rise to prosecution history estoppel, a court first must determine what claim limitations are alleged to be met by equivalents, whether the limitations at issue were amended during prosecution, and whether a patentee's amendment narrowed the literal scope of the claim. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 234 F.3d 558, 586, 56 USPQ2d 1865, 1886 (Fed. Cir. 2000) (*en banc*), *cert. granted*, 121 S.Ct. 2519 (2001). "[A] narrowing amendment made for any reason related to the statutory requirements for a patent will give rise to prosecution history estoppel with respect to the amended claim element." *Id.* at 566, 56 USPQ2d at 1870.

Bose alleges that the "ellipse having a major diameter" limitation, found in new claim 1 of the '721 patent, can be

met by an equivalent and was not narrowed during prosecution. We must review the amendments to original dependent claim 2, which was rewritten as new claim 1 during prosecution, to determine if Bose narrowed the scope of the claim. It is this new claim 1 which contains the "ellipse having a major diameter" limitation here at issue. As originally filed, claim 2 was objected to as being dependent upon a rejected base claim (original claim 1), but would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims. After being rewritten as new claim 1, the examiner required Bose to add the phrase "having a major diameter" to provide an antecedent basis for the reference to the term in issued claim 3 (original claim 4), thereby complying with the definiteness requirement of 35 U.S.C. § 112, ¶ 2. JBL argues that this amendment narrowed the claim limitation, and therefore, no range of equivalents is available.

The section 112 issue raised by JBL, with respect to the "ellipse having a major diameter" claim limitation, is not one of sufficiency of the disclosure, but rather precision of the claim. Issued claim 3 (original claim 4) disclosed the "major diameter of said ellipse," while new claim 1 recited only "an ellipse." The Manual of Patent Examining Procedure ("MPEP") states: "the failure to provide explicit antecedent basis for terms does not always render a claim indefinite. If the scope of a claim would be reasonably ascertainable by those skilled in the art, then the claim is not indefinite." MPEP § 2173.05(e) (6th ed. Rev. 1, Sept. 1995); *see Ex parte Porter*, 25 USPQ2d 1144, 1146 (Bd. Pat. Apps. & Int. 1992); *see also In re Moore*, 439 F.2d 1232, 1235, 169 USPQ 236, 238 (CCPA 1971) ("[T]he definiteness of the language employed must be analyzed--not in a vacuum, but always in light of the teachings of the prior art and of the particular application disclosure as it

would be interpreted by one possessing the ordinary level of skill in the pertinent art.").

The antecedent basis rejection, as applied to the facts of this case, does not narrow the scope of the claim because it would be reasonably ascertainable by those skilled in the art that an ellipse is inherently understood to have "a major diameter." There can be no dispute that mathematically an inherent characteristic of an ellipse is a major diameter. The prior recitation of "an ellipse" therefore, provides the antecedent basis for "an ellipse having a major diameter." "Inherent components of elements recited have antecedent basis in the recitation of the components themselves." MPEP § 2173.05(e). The MPEP provides an analogous example: "the limitation 'the outer surface of said sphere' would not require an antecedent recitation that the sphere have an outer surface." Id.

Because Bose's amendment did not satisfy the "narrowing amendment" requirement of *Festo*, 234 F.3d at 566, 56 USPQ2d at 1870, we see no need to examine the reason why the applicant amended the claim. The district court properly denied the motion for summary judgment of non-infringement under the doctrine of equivalents because a reasonable jury could have returned a verdict for the nonmovant.

Next, JBL argues that the district court abused its discretion by refusing to permit the inclusion of the Dehaeze French patent application ("Dehaeze reference") during trial. We apply regional circuit law to procedural questions that are not themselves substantive patent law issues so long as they do not: (1) pertain to patent law, *Flex-Foot, Inc, v. CRP, Inc.*, 238 F.3d 1362, 1365, 57 USPQ2d 1635, 1637 (Fed. Cir. 2001) ("[W]e will apply our own law to both substantive and procedural issues 'intimately involved in the substance of enforcement of the

patent right'" (citation omitted)); (2) bear an essential relationship to matters committed to our exclusive control by statute; or (3) clearly implicate the jurisprudential responsibilities of this court in a field within its exclusive jurisdiction, *Midwest Indus., Inc. v. Karavan Trailers, Inc.*, 175 F.3d 1356, 1359, 50 USPQ2d 1672, 1675 (Fed. Cir. 1999) (*en banc* in relevant part). Because the exclusion of evidence does not meet any of these criteria, we apply the law of the First Circuit.

The First Circuit reviews "the exclusion of evidence for an abuse of discretion." *Achille Bayart & CIE v. Crowe*, 238 F.3d 44, 49 (1st Cir. 2001). Additionally, it reviews "a trial court's Rule 403 balancing for an abuse of discretion, and only in 'extraordinarily compelling circumstances' will [it] reverse the district court's judgment concerning the probative value and unfair effect of the proffered evidence." *United States v. Rosario-Peralta*, 199 F.3d 552, 561 (1st Cir. 1999) (citations omitted). That circuit also "afford[s] wide latitude to trial courts in these purlieus, taking care to 'evaluate the trial court's decision from its perspective when it had to rule and not [to] indulge in review by hindsight.'" *United States v. Winchenbach*, 197 F.3d 548, 559 (1st Cir. 1999) (citing *Old Chief v. United States*, 519 U.S. 172, 182 n.6 (1997)); *accord Nat'l Presto Indus., Inc. v. W. Bend Co.*, 76 F.3d 1185, 1197, 37 USPQ2d 1685, 1694 (Fed. Cir. 1996) ("We review the district court's evidentiary rulings with extreme deference.").

JBL sought inclusion of the Dehaeze reference to establish its affirmative defenses of invalidity and non-infringement. It claims that had the district court considered the Dehaeze reference, it would have concluded that the reference rendered the '721 patent invalid under either 35 U.S.C. § 102 or § 103. Bose argued that it would be unfairly prejudiced by the inclusion of the Dehaeze

reference well after the final pre-trial order and on the seventh day of trial.

The district court determined that the Dehaeze reference disclosed a hyperbola, which is different, in both shape and mathematical formula, from an ellipse. The court also observed that it would have weighed the Dehaeze reference differently, in the interest of justice, if it had disclosed an ellipse. Lacking probative value, the court found the disclosure of the Dehaeze reference untimely, noting that the reference could have been discovered earlier with due diligence and to allow it would unfairly prejudice Bose. We see no abuse of discretion.

Finally, while JBL does not appeal the district court's lost profits determination, it argues that the court erred in determining the applicable royalty base because it represents an amount that the parties would never have agreed upon. Specifically, JBL asserts that the royalty was calculated based on the entire value of the loudspeaker systems incorporating the accused ports, even though they only comprised a small component of the system.

A patentee is entitled to no less than a reasonable royalty on an infringer's sales for which the patentee has not established entitlement to lost profits. 35 U.S.C. § 284 (1994). In determining the appropriate basis for calculating a royalty base the court may use the "entire market value rule." *Fonar Corp. v. Gen. Elec. Co.*, 107 F.3d 1543, 1552, 41 USPQ2d 1801, 1808 (Fed. Cir. 1997). "We have held that the entire market value rule permits recovery of damages based on the value of a patentee's entire apparatus containing several features when the patent-related feature is the 'basis for customer demand.'" *Rite-Hite Corp. v. Kelley Co., Inc.*, 56 F.3d 1538, 1549, 35 USPQ2d 1065, 1072-73 (Fed. Cir. 1995) (*en banc*)

(citing *State Indus., Inc. v. Mor-Flo Indus., Inc.*, 883 F.2d 1573, 1580, 12 USPQ2d 1026, 1031 (Fed. Cir. 1989)).

The district court found that the invention of the '721 patent inextricably worked with other components of loudspeakers as a single functioning unit to provide the desired audible performance. The court also found that the invention of the '721 patent improved the performance of the loudspeakers and contributed substantially to the increased demand for the products in which it was incorporated. Bose presented unrebutted evidence that the invention of the '721 patent was integral to the overall performance of its loudspeakers by way of the elliptical port tube, which eliminated port noise and reproduced improved bass tones. JBL's marketing executive also acknowledged that improved bass performance was a prerequisite for JBL's decision to go forward with manufacturing and selling certain loudspeakers. Bose presented evidence detailing its efforts to market the benefits of its loudspeakers using the invention of the '721 patent and provided testimony on its increase in sales in the year following the introduction of its speakers containing the invention. All of this was substantial evidence to support an award of a reasonable royalty based upon the entire value of the loudspeakers.

We have considered the remainder of JBL's arguments but find none of them persuasive.

CONCLUSION

Accordingly, we affirm the judgment of the United States District Court for the District of Massachusetts.

AFFIRMED

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

BOSE CORPORATION *Plaintiff,* v. JBL, INC., And INFINITY SYSTEMS CORPORATION, *Defendants.*	Civ. No. 98-10209 DISTRICT JUDGE PATTI B. SARIS
JBL, INC., And INFINITY SYSTEMS CORPORATION, *Counter-Claimants,* v. BOSE CORPORATION, *Counterclaim Defendant.*	

MEMORANDUM AND ORDER

August 31, 2000

SARIS, U.S.D.J.

I. INTRODUCTION

In this patent infringement case, plaintiff Bose Corporation accuses defendant JBL, Inc. and Infinity Systems Corp. (collectively, "JBL") of infringing U.S. Patent No. 5,714,721, entitled "PORTING" ("the '721 patent"), which relates to a port inside a loudspeaker enclosure used to radiate acoustic energy from inside the speaker to the awaiting listener outside the speaker. Bose seeks a finding that JBL willfully infringed the patent by incorporating the '721 invention in several of its speaker models and continuing to sell those products even after

JBL learned of the patent. Bose seeks damages in the form of lost profits, reasonable royalties, and a permanent injunction. Bose also seeks trebling of its damages and attorneys' fees.

JBL maintains that several of its products are non-infringing, and as to its admittedly infringing products, asserts that the '721 patent is invalid on the grounds of obviousness and prior sale/offer for sale in the United States.[1]

After a jury-waived trial, I ***ORDER*** entry of judgment for the plaintiff, Bose. Bose is awarded damages of $5,676,718.32. I also ***ORDER*** that a permanent injunction enter, enjoining the defendants from further infringement of the '721 patent.

II. FINDINGS OF FACT AND CONCLUSIONS OF LAW

A. Background

1. The Parties

Both parties are in the business of making loudspeakers and audio equipment. Plaintiff Bose Corporation ("Bose") was founded by Dr. Amar Bose about thirty-five years ago, and makes loudspeakers and audio equipment for the consumer and automotive market. Bose

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[1] *Products JBL admits are covered by claim 1 and the Court has adjudicated as infringing.* These products are: MUSIC 10, MUSIC 15, MUSIC 20, SCS 110, SCS 115, SCS 116, SCS 120, ESC 550, SPK 550, Bass 10, Bass 15, Bass 16, Bass 20, Festival 80, Bass 550, SVA 1500, SVA Center S50, ESC300 and SUB300.

Products JBL contends do not infringe. The JBL products are: N24, N26, N28, N38, ND310, N-Center, TLX271, S26, S38, S310, S312, PSW-D110 (and DPS 110), PSW-D112 (and DPS 112), PSW-D115 (and DPS 115), ESC300B, ESC350, SCS125, S-Center, ESC333 and NSP1 (includes N24 and N-Center). The Infinity products are: HPS250, HPS500 RS8, and RS10.

also makes headsets for pilots and passengers of commercial aircraft.

The defendant, JBL, Inc. ("JBL") was founded by James B. Lansing in the 1940's, and is also in the business of designing and manufacturing loudspeakers. JBL entered the consumer loudspeaker business in the 1950's, and has been in the business since that time. Defendant Infinity was founded by three aerospace engineers in the late 1960's. Infinity set out to integrate aerospace engineering technology into the audio industry to improve performance of music systems. Infinity introduced the industry's first satellite/subwoofer[2] speaker system. Both JBL and Infinity are owned by Harmon, International.

2. Designing Loudspeakers: The Basics

In modern loudspeaker systems, sounds are created by a "transducer." A transducer converts electrical energy into acoustical energy by moving a suspended paper or metal diaphragm forward and backward in a linear manner. The movement of this diaphragm acts as an air pump, which creates sounds that are recognizable by the human ear.

In an early loudspeaker design, called a "bass reflex" design, the transducer is mounted in a box that has a specially designed opening called a port, or vent. In a bass reflex speaker, most of the sound or acoustic energy radiates from the loudspeaker enclosure directly from the transducer itself. Specifically, the transducer radiates the bass sound into the listening environment throughout

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[2] A subwoofer loudspeaker is used to extend the low frequency range of full-range systems to include frequencies as low as 20 or 30 Hertz (Hz). The unit Hertz is used to measure frequency in cycles per second. Frequency corresponds to the musical attribute of pitch. See Gary Davis & Ralph Jones, *Sound Reinforcement Handbook* (2d. Ed. 1970) ("*Handbook*") for a basic primer on sound characteristics.

much of the lower frequency range (i.e., sounds that have a low pitch). The port opening is used to create a "Helmholtz resonance," which is a sound that is created when air moves across the surface of any opening.[3] By creating a Helmholtz resonance, the port serves to expand the range of bass sounds a speaker can produce at the lowest frequencies.

After the bass reflex design, loudspeaker engineers developed the "coupled cavity" or "band pass" system, which is a fully enclosed box whose only opening is the port. In a band pass system, the transducer is housed completely within the enclosure and all sound radiates from ports. Here, the port assumes a more important role because it is the source of all sound.

Ideally, the sound radiating from a speaker accurately represents the sound intended to be played. For example, if a stereo system sends a single pure tone to the speaker, then the speaker should respond with a single pure tone. However, in actuality, no speaker system is perfect, and various acoustic phenomena come into play. These include: nonlinearity; harmonic distortion; and port noise. A brief description of each of these concepts is important, because they highlight the challenges posed by loudspeaker design, the particular role of the port, and the function of the '721 invention.

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[3] One of the most common examples of a Helmholtz resonance is the sound created by blowing across the top of a soda bottle. When air moves across the opening, the volume of air inside the opening (known as the "acoustic mass") begins to move forward and backward, creating sound in much the same manner as the suspended diaphragm of a speaker transducer. Much like a soda bottle can be tuned by adding or subtracting liquid from its contents, the acoustic mass of a port tube can be tuned to various frequencies by altering the mass of air in the enclosure and the size of the port tube.

Nonlinearity, or compression, is the term used to describe the nonlinear relationship between the input into the speaker, in terms of electrical power, and the output in terms of sound pressure level.[4] Ideally, there would be a direct relationship between input (measured in volts) and output (measured in decibels) such that a graph depicting that relationship would form a straight line. In reality, however, the output does not measure up to what one would expect given the input. One of the functions of a port tube is to maximize the degree to which the input and output share a linear relationship.

Two other "impurities" that affect the quality of the sound created by the speaker are harmonic distortion and port noise. Harmonic distortion consists of extraneous sounds at precise frequencies that are multiples of the base frequency.[5] For example, in a loudspeaker playing a 50 hertz (Hz) tone, harmonic distortion occurs at 100 Hz, 150 Hz, 200 Hz, 250 Hz and so on. The effect of harmonic distortion is to change the sound by destroying the purity of the pitch. Harmonic distortion is a distinct source of unwanted extraneous sound, and can be measured separately. A good port will work to minimize the level of harmonic distortion.

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[4] Sound pressure level is measured in decibels. A decibel, or "dB," describes a ratio of two quantities, most often related to power. The dB describes the level measured per unit area at a particular location relative to the sound source. "0" dB sound pressure level is the threshold of human hearing. Average conversation has a sound pressure level of about 70 dB.

[5] Sound travels in fluctuating waves of pressure. A single complete cycle of an acoustical pressure wave consists of one half cycle of compression of the air molecules, followed by one half cycle of rarefaction (or expansion) of the air molecules. Frequency is the rate of this air pressure fluctuation. As noted above, frequency is measured in units called Hertz (Hz).

Port noise consists of the extraneous sounds produced across the frequency spectrum. Port noise is a particular problem at high volume levels where large amounts of air must be moved back and forth within the port. The larger the volume of air moving through the port, the more erratic and "jumbled" the air flow becomes. This erratic behavior of the air as it moves through and exits the port tube is known as turbulence. Turbulence in the port creates port noise, which, at least in one form, makes a "chuffing" sound. Chuffing is similar to the buffeting sound created when a car window is rolled down on a highway. If it is present, port noise is the most notable thing a listener would hear. Thus, a good port design should also minimize port noise.

3. Port Noise Complaint

In 1987, Bose introduced a three-piece loudspeaker design called the Acoustimass 5, consisting of a bass module and two small satellite speakers. The bass module produced the lower frequency, or bass, sounds while the satellite speakers produced the higher frequency sounds. The concept behind the Acoustimass system was to produce "virtually invisible" loudspeakers by building a bass module that could be hidden anywhere in a room, and having small satellite speakers to reproduce the higher pitched notes. For the system to work properly, the listener must not be able to detect where the bass sound is coming from; the sound should be "nonlocalizable." From the listener's perspective, all bass sound should appear as if it is radiating from the small satellite speakers.

The bass module of the Acoustimass 5, Series I was a band pass design, with the output transducers (or

"woofers,"[6] as they are known in the industry) buried within the enclosure itself. Essentially, all of the sound generated by the woofers radiated from the port in the side of the enclosure. The bass module of the Series I used straight, cylindrical ports. However, when the Series I system was played loudly, the bass module would emit port noise. The port noise contained higher frequency components, or chuffing, giving away the location of the bass module. This destroyed the "nonlocalizability" feature that was a goal of the system.

The port noise problem became a focus of Bose engineers as they set out to design the Acoustimass 5, Series II bass enclosure to replace the predecessor Series I. Engineer Brian Gawronski began experimenting with a prototype bass box, first altering the cylindrical port tube by placing flared ends on the input and output side. After informal testing, Gawronski concluded that these ends would not provide a significantly better performance than the straight cylindrical port tube. Gawronski confirmed this belief by devising a test to measure quantitatively port noise. In the test, a computer generated a 50 Hz pure tone that was played by the bass module under test, and a microphone was placed about four or five inches away from the bass module. The computer applied the tone, and recorded the sound pressure produced by the 50 Hz tone being picked up by the microphone. The computer generated a graph with this data, showing the output of the bass module. Gawronski recorded these graphs in his notebook, which showed that the straight port with rounded flared ends exhibited some improvement over the straight cylindrical port. Gawronski did not consider that

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[6] A woofer is a type of output transducer designed specifically to reproduce low frequencies (usually below 500 Hz). *See Handbook, supra* note 2, at 5.

improvement to be sufficient, however, and continued to struggle with the port noise problem.

In the spring of 1990, Gawronski shared his port noise complaint with his cubicle neighbor at Bose, engineer Gerald Caron. Inspired by a drawing of a jet aircraft engine on his wall, Caron suggested that Gawronski try shaping the input end of the port to resemble the intake of a jet engine. Not knowing what else to try, Gawronski took the suggestion. Gawronski recalled thinking that jet engines presumably had to work hard to get a smooth flow of large amounts of air into the engine at high speeds. He gave a copy of the jet engine drawing to his designer, who made "flares" for him in the model shop. Each flare later became an intake and output end of the port. After making the flares, the designer told Gawronski that the shape of the intake followed an ellipse.

Gawronski then installed the elliptical flares into his prototype bass module and listened to them at the lab bench. He eventually experimented with two back-to-back flares to form an elliptical port. When Gawronski tested the prototype with the back-to-back elliptical flares, the port noise problem was gone.

The elliptically flared port showed a 30 to 40 dB improvement over the straight cylindrical port, with 30 dB being about 32 times better and 40 dB being about 100 times better. With those results, Gawronski considered the port noise problem to be solved. The elliptical port design was incorporated in the Acoustimass 5, Series II.

B. The '721 Patent

1. The Disputed Claim

On February 3, 1998,[7] the U.S. Patent and Trade Office issued to Bose the '721 patent, which discloses and claims a loudspeaker enclosure with an elliptical port. The only independent claim, Claim 1,[8] reads as follows:

> A loudspeaker enclosure with at least one port for radiating acoustic energy to a region outside said enclosure and having an inside volume,
>
> said at least one port having an axis and characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared output end within said inside volume,
>
> wherein said port defines a boundary between the acoustic mass therein and said inside volume,
>
> said boundary being defined by an ellipse having a major diameter.

The only claim term in dispute in this case is the phrase "said boundary being defined by an ellipse having a major diameter." The defendants concede that all the other limitations of claim 1 are met by the accused products. This Court has construed the phrase "ellipse having a

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[7] The filing date of the application from which the '721 patent issued was October 29, 1996. The patent is a continuation of Ser. No. 843,858, February 27, 1992, abandoned, which is a continuation-in-part of Ser. No. 621,531, Dec. 3, 1990, Pat. No. 5,092,424.

[8] The parties agreed to litigate claim 1 only, and to have the court's findings apply with equal force to dependent claims 2 and 4.

major diameter" to mean the geometric definition of ellipse, a shape defined by the formula:

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

where "a" and "b" are constants. *See Bose Corp. v. JBL, Inc.*, 98 F.Supp.2d 80, 85-86 (D.Mass.2000).

2. Bose's Use of the '721 Patent Invention

In addition to the Acoustimass 5, Series II, Bose incorporated the '721 invention into subsequent Acoustimass and Lifestyle products. These include: the Acoustimass 5, Series III; Acoustimass 6; Acoustimass 7; Acoustimass 10; and Acoustimass 15 loudspeaker systems. Bose also incorporated the invention into its "Lifestyle" music systems and home theater products, including: the Lifestyle 5; Lifestyle 20; Lifestyle 25; Lifestyle 8; Lifestyle 12; Lifestyle 30; Lifestyle 40; and Lifestyle 50. In addition, Bose sells powered speakers that can be combined with a Lifestyle system to provide music to another room of a house, either in stereo or home theater sound. These speakers also contain the invention of the '721 patent.

3. Meanwhile, over at JBL . . .

In 1994, JBL was selling two stereo products, the MUSIC 1 and MUSIC 2, which Bose claims competed with its Acoustimass 5, Series II system. The MUSIC 1 had four components: two bass modules, or subwoofers, and two satellite speakers. Each bass module included a cylindrical port with radiused ends. These systems had not been selling well in the marketplace. The engineers at JBL and Infinity were also struggling with the deficiencies of the straight cylindrical port tube. Sometime in the spring of 1995, JBL engineer Allan Devantier approached a mechanical engineer, Mona Lisa Alexander, and asked

her to design a port tube that would minimize port noise and distortion. Ms. Alexander did not know initially the particular product for which she was designing the port tube; she later found out it was to be used for the redesign of the MUSIC 2 bass module. She understood that her goals in designing the port tube were to minimize noise, turbulence, and harmonic distortion in the port tube to improve its overall performance.

Ms. Alexander, who has a degree in aeronautical engineering, drew upon her knowledge of fluid dynamics and mechanics as she set out to design her port tube. After finding nothing helpful in the audio engineering scholarship she consulted, she looked to a fluid mechanics textbook for guidance. Analogizing the port tube to a duct for transmitting fluid, Ms. Alexander concluded that both ends of the port tube should be flared and should have gradual transitions with an inlet that slowly converges and an outlet that slowly diverges. After adapting an illustration in her text that showed an inlet for a nozzle defined by a quarter of an ellipse, Ms. Alexander then realized that given her parameters, she would need to alter the figure used in the book. She decided upon an ellipse profile.

Having settled upon the shape for the port tube, Ms. Alexander designed a computer model of the port tube. Next, actual prototypes were created and tested acoustically. Ms. Alexander did not participate in that testing. At some point during the testing, Ms. Alexander was asked if she'd like to see the prototype port tube installed in a bass module. She agreed, and went to a room where there were several bass modules. Ms. Alexander recalls seeing a Bose Acoustimass 5, Series II bass module in the room at that time, but had not seen one previously. It was Ms. Alexander's belief that JBL

had acquired a Bose module for comparative listening tests.

Ms. Alexander adamantly (and credibly) denies that she copied the Bose module in designing her port tube for JBL. Mr. Devantier, however, admitted that JBL acquired Bose speakers to compare their acoustic features to JBL's new systems. Moreover, in his monthly report updating the development of the MUSIC 10 series (the successor to the MUSIC 1), Devantier explicitly stated that the JBL prototype "will incorporate all the acoustic improvements we have been able to identify in a Bose subwoofer shaped box." Devantier explained that he only meant to refer to the rectangular shape of the Bose subwoofer box. I do not find this explanation credible. Devantier's Product Brief of May 23, 1995 also links the JBL design directly to the Bose Acoustimass 5 ("AM5") bass module, with an instruction to: "replace two small subwoofers with one subwoofer similar to the Bose AM5 subwoofer." Certainly, Mr. Devantier was familiar with the design and engineering of the Bose AM5. The ultimate design of the MUSIC 10 was very similar to the Bose AM5; indeed, there was internal concern expressed to Devantier about those similarities.[9]

JBL also mimicked Bose's marketing and trademark approaches in various ways. For example, JBL has used "Lifestyle," a Bose registered trademark, to refer to its line of MUSIC 10 and MUSIC 20 products. Although Ms. Alexander independently conceived of an elliptical port, in other respects JBL did set out to copy the acoustic improvements, and market strategy for, the Bose subwoofer.

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[9] In an internal memo to Devantier from Luis Esparza, one of Devantier's "team members," Esparza wrote: "The bottom line is that the resemblance of the current design to Bose is, in general, objectionable." *See* Exh. 280.

JBL became aware of the '721 patent almost immediately after its issuance in February of 1998; indeed, Bose filed this suit on the same day the patent issued. JBL did not obtain an independent written opinion of counsel on JBL's legal posture in continuing to manufacture or sell speakers with elliptical ports. Instead, JBL relied on the advice of its counsel retained for its defense to the infringement suit. At that point, JBL was aware that several of its ports did contain an elliptical port tube, which the '721 patent specifically called out. JBL considered retrofitting those products with non-elliptical ports, but did not do so. It is unclear whether or not JBL immediately stopped manufacturing all the products containing the elliptical port tube, but JBL did discontinue production of at least some of those products. But it is clear that JBL continued selling from its stock some of its products with elliptical ports.

JBL then set out to design around the '721 patent, aiming to make a port that was not a mathematical ellipse. Engineer Gregory Timbers, alerted to the existence of the patent by his superiors, began considering alternative shapes. Working with certain exponential equations, Timbers developed a smoothly flared port that he believed would not infringe the patent because it was not an ellipse. The result became known as the "exponential" port tube. Timbers alerted JBL Vice President Floyd Toole to this new port flare and showed him the math that defined it. Mr. Devantier also set out to design around the '721 patent. He considered the properties of air flow, and the fact that the air in the tube would be accelerating quickly, then decelerating as it exited the tube. He developed three port shapes with smooth, continuous curves, and ran tests to measure their performance. He concluded that one port, which he called the Linear A, showed the most promise. He then gave his

design engineers certain parameters so they could design the actual tube.

C. Infringement

1. Literal Infringement

An accused device may infringe in one of two ways: literally, or under the doctrine of equivalents. "Literal infringement requires that the accused device contain each limitation of the claim exactly; any deviation from the claim precludes a finding of literal infringement." *Litton Sys., Inc. v. Honeywell, Inc.*, 140 F.3d 1449, 1454 (Fed. Cir. 1998). Determination of infringement, whether literal or under the doctrine of equivalents, is a question of fact. *See Bai v. L & L Wings, Inc.*, 160 F.3d 1350, 1353, 48 USPQ2d 1674, 1676 (Fed. Cir. 1998).

In accordance with this Court's construction of claim 1, Bose claims that JBL's Linear A and exponential port tubes[10] are, in fact, mathematical ellipses to one skilled in the art of loudspeaker design. Bose engineer Michael O'Connell, who has a masters degree in the field of human auditory perception and is pursuing a doctorate in electrical engineering at M.I.T., testified that by comparing laser scans of sample JBL port profiles, overlaid with a mathematical ellipse, certain of the JBL port boundaries coincide with a mathematical ellipse. As an example, O'Connell took a laser scan of JBL's N24 port boundary (in other words, scanned an actual port), used a computerized graphics program to generate a mathematical ellipse, and overlaid the laser scan with the ellipse. (*See* Exh. 111, attached). From a visual inspection, the two are indeed difficult to distinguish. O'Connell testified that, in the context of real world port

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[10] The JBL models which incorporate the Linear A or exponential port tubes are: N24; N28; N38; S26; S38; S312; ESC 300B/350; SCS125; HPS500; SCenter; and ESC333.

construction, the N24 port boundary would be considered to be defined by a mathematical ellipse. O'Connell offered the same opinion as to the other disputed JBL models.

JBL's expert, Douglas Button, refuted O'Connell's testimony that the laser scan with an ellipse overlaid demonstrated that JBL's N24 boundary, for example, was defined by an ellipse. Button measured the differences between the laser scans of the JBL port tubes and the ellipses superimposed by O'Connell. Looking at each port tube, Button measured the differences in the cross-sectional radii between the two curves. The largest difference was exhibited by the SCS 125 port, which, at one point, deviated by 75 thousandths of an inch from the ellipse. The smallest difference was exhibited by the N24 port, which had a maximum difference of 10 thousandths of an inch. JBL also introduced evidence that the differences in radii of the actual ports as compared to the superimposed elliptical curves would result in a difference in the cross-sectional area of the portal between 4 and 12 percent. Bose tried to argue that such a disparity is meaningless in the "real world" of port design. There was also much back-and-forth over whether the differences between the accused ports and a perfect ellipse would fall within "manufacturing tolerances."

After considering all the evidence, I find that the accused port tubes incorporating the Linear A and exponential curves do not literally infringe the '721 patent. Despite extremely close visual similarities, literal infringement precludes *any* deviation from the claim as construed.

2. Doctrine of Equivalents

An accused device that does not infringe literally may still infringe under the doctrine of equivalents, if the patent holder shows that the accused device performs substantially the same function, in substantially the same

way, to produce substantially the same result as the claimed invention. *See Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 608, 70 S.Ct. 854, 94 L.Ed. 1097 (1950); *Johnston v. IVAC Corp.*, 885 F.2d 1574, 1581 (Fed. Cir. 1989).

Based on all the evidence, I make the following findings.

Function. The function of the '721 patent is to couple energy from within the speaker enclosure to the environment outside the speaker enclosure and to reduce or prevent audible noise associated with air flow through the port. The function is spelled out within the patent itself, which makes reference to "a port or tube for radiating acoustic energy to the region outside a loudspeaker enclosure smoothly flared at each end" and highlights the "tapered cross section of the flared port [that] helps reduce turbulent airflow that might cause audible noise when radiating at high velocity levels." *See* Exh. 1, column 1, lines 8-10, 23-25; column 2, lines 22-25.

JBL's expert, Mr. Button, agreed with O'Connell that the JBL ports perform the same function as the elliptical port of the '721 patent, though he points out that all ports perform several other functions as well. "Infringement under the doctrine of equivalents is not precluded merely because the accused device performs functions in addition to those performed by the claimed device." *Insta-Foam Prods., Inc. v. Universal Foam Sys.*, 906 F.2d 698, 702 (Fed. Cir. 1990). The Court may look at the intrinsic evidence in the patent to discern the function of the claimed invention. *See Hill-Rom Co., Inc. v. Kinetic Concepts, Inc.*, 209 F.3d 1337, 1341 (Fed. Cir. 2000) (looking in an equivalents analysis to specification to discern "major objectives" of the cushions recited in the claims).

Way. The way in which the '721 port accomplishes the function is by virtue of the flaring at both ends of the port tube, the continuous curvature of the port, and the decreasing cross-sectional area of the port from either end of the port to its center.

Despite undeniable evidence that the Linear A and exponential ports also have a continuous curvature, flaring at both ends, and a decreasing cross-sectional area throughout, JBL offered evidence to rebut Bose's argument that the ports perform in substantially the same way. JBL offered the testimony of its engineers, including Button and Devantier, who conducted a series of tests and measurements of various port tubes, including those with boundaries defined by an ellipse, an exponential curve, and a Linear A curve. Mr. Button testified that the JBL ports have a gentler flare rate toward the center of the port, which causes "turbulent eddies," or little tornadoes of port turbulence, to form further down the port than they would in a port defined by an ellipse. But Button had no empirical or analytical data to support his opinion that these "eddies" form in a substantially different way in JBL's ports.

Mr. Devantier testified that he, in fact, purposely avoided measuring the "turbulent eddies" that create port noise because they would create randomness in his tests measuring harmonic distortion. Finally, even if one accepts that turbulent eddies may form at different places along a port tube of an ever-so- slightly different shape, this does not rise to the level of a substantial difference in the way the ports operate to reduce port noise to inaudible levels. So, this basis for distinction was unpersuasive.

Based on all the testimony, and given the specific function of the '721 patent, I find that the JBL ports operate in substantially the same way as a port boundary defined by an ellipse having a major diameter.

Result. The result of the '721 patent invention is the reduction of port noise to inaudible levels when the speaker is played at high volume levels. The patent itself states that "the particular curvature is preferably such as to enclose a volume of predetermined acoustic mass while producing inaudible noise at relatively high power levels." *See* Exh. 1, col. 2, lines 22-25. Mr. O'Connell offered his opinion that, given the laser scans of the JBL port tubes, and the listening tests he conducted, the JBL ports function in substantially the same way to achieve substantially the same result as the '721 patent invention. Specifically, the minimal visual differences, in conjunction with the continuous curvature, smooth flare, and continuous decrease in cross-section from the ends of the port to the center, with the result that no port noise is audible, led O'Connell to this conclusion.

O'Connell did not perform empirical measurements on the JBL products accused of infringement. However, based on his background in human acoustic auditory perception and in loudspeakers, he performed listening evaluations. He used a reference listening room at Bose to evaluate the JBL SCS 125 with a track of Madonna's "Erotica" (not, unfortunately, in evidence) and heard no audible port noise. This contrasted with his testing of JBL's MUSIC 1 which did have audible port noise.

In response, Mr. Button testified that the result of the curvatures in the JBL port tubes is different than that of the curvature in the '721 patent. His opinion is based upon a paper he and Devantier presented to the Audio Engineering Society ("AES"). In that paper, Button and Devantier reported the results of their tests of several different port designs, including the ellipse, Linear A and exponential port curves. Significantly, no JBL engineer performed these tests on any of the ports at issue in this case. Moreover, the tests performed in the AES study did

not specifically measure port noise, but compared the different ports' performance in the areas of harmonic distortion and linearity. Although Devantier suggested that measurements of harmonic distortion could be correlated to port noise induced by turbulence, Devantier also acknowledged that harmonic distortion exists independently. JBL engineer Greg Timbers also testified that turbulence-driven port noise and harmonic distortion are two different concepts.

Bose's expert, Mr. O'Connell, further undercut the usefulness of the AES study. O'Connell testified that he knew of no way to predict whether a port will decrease port noise at high levels by measuring harmonic distortion. Although the AES results show some differences among the different port tube designs in harmonic distortion characteristics, the study is not helpful in assessing whether JBL's ports reduce port noise in a different way, or with a different result, than the Bose ports. O'Connell showed graphically that the differences in result with respect to harmonic distortion did not correlate with any minor differences in result with respect to port noise.

I conclude that the AES study, which did not test the ports at issue and which measured port functions other than reducing port noise, is of limited use here. Similarly, the descriptions of how "turbulent eddies" would form differently in a port of slightly different shape do not rebut the compelling evidence of nearly indistinguishable port profiles that both reduce port noise to an inaudible level. I find that any differences in the results achieved by the slightest tweak in the curvature are not substantial.

Throughout this trial, JBL has urged me to see the emperor's new clothes. The ports look the same to the naked eye; the laser scans and measurements demonstrate that any differences in the curvature are de

minimus. The ports sound the same to the naked ear with respect to the elimination of chuffing; no tests demonstrated perceptible audible differences. In sum, I find that the JBL port tubes defined by the Linear A and exponential curve formulas perform the same function in substantially the same way, with substantially the same result, and therefore infringe the '721 patent under the doctrine of equivalents.

D. Invalidity

A patent is presumed valid, and the burden of proving invalidity rests with the challenger. *See* 35 U.S.C. § 282. Invalidity must be proven by facts that are supported by clear and convincing evidence. *See National Presto Indus. v. West Bend Co.*, 76 F.3d 1185, 1189 (Fed. Cir. 1996). JBL contends that the '721 patent is invalid, under two different theories.

1. Prior Sale/Offer for Sale, 35 U.S.C. § 102(b)

First, JBL claims that the invention of the '721 patent was "in public use or on sale in this country, more than one year prior to the date of the application for patent ..." 35 U.S.C. § 102(b). Here, then, only prior art that existed more than one year prior to the effective filing date of the '721 patent application, December 3, 1990, serves as the basis for a section 102(b) invalidity argument.

To succeed on this theory, JBL must demonstrate, by clear and convincing evidence, that there was a definite sale or offer to sell more than one year before the application for the subject patent, and that the subject matter of the sale or offer to sell fully anticipated the '721 patent invention or would have rendered the '721 patent invention obvious by its addition to the prior art. *See STX, LLC v. Brine, Inc.*, 211 F.3d 588, 590 (Fed. Cir. 2000); *Tec Air, Inc. v. Denso Mfg. Mich., Inc.*, 192 F.3d 1353, 1358 (Fed. Cir. 1999) (citations omitted); *see also*

Scaltech, Inc. v. Retec/Tetra, L.L.C., 178 F.3d 1378, 1383 (Fed. Cir. 1999) ("[T]he first determination in the § 102(b) analysis must be whether the subject of the barring activity met each of the limitations of the claim, and thus was an embodiment of the claimed invention."). "The ultimate determination that a product was placed on-sale under § 102(b) is a question of law based on underlying facts." *Ferag AG v. Quipp, Inc.*, 45 F.3d 1562, 1566 (Fed. Cir. 1995). JBL does not come close to meeting its burden with respect to a § 102(b) challenge to patent validity.

JBL contends that activities associated with a loudspeaker called the "Glastonbury II" created prior art that anticipates claim 1 of the '721 patent under § 102(b). To make its case, JBL relied on the testimony of a colorful audiophile named James Maxwell Townshend, owner of Townshend Audio in London, and his investor/customer, David Davies. According to Townshend, sometime in the early 1980's, he developed the first version of the Glastonbury II, a bass reflex loudspeaker that had a port that was a doubly flared pipe. Townshend testified that the flares in this original version were plastic, were joined by a cylindrical sleeve, and when connected were in the shape of an ellipse.

Sometime in the beginning of 1987, Mr. Townshend changed the design of his speaker and started manufacturing the second version of the Glastonbury II. Townshend switched from plastic flares to aluminum spinnings for his port, which were also joined by a cylindrical plastic pipe. Townshend testified that the aluminum flares on each end of the cylindrical pipe were supposed to be elliptical in shape, although he acknowledged that the port may have had a tapered or flattened section as a result of the manufacturing process. He claimed that this second version of the Glastonbury II was sold in Great Britain and other parts of Europe in

1987. But this second version was just too large, and in response to customer complaints, Townshend switched to a third version of the Glastonbury II to reduce the weight of the speaker. He testified that the third version had an aluminum enclosure with reduced depth; this change necessitated a change to a longer port. That longer port was not elliptically shaped; it had a straight cylindrical section in the middle.

Townshend testified that his company shipped one pair of Glastonbury II speakers to the United States, to a Mr. David Davies, a friend of Townshend's who had invested money in Townshend's business. Townshend testified that he sent the third version of the speakers to Davies in late 1987, or in the early part of 1988. Townshend's memory as to the timing of the shipment was, to say the least, shaky; he changed the date while on the witness stand, and acknowledged that he had repeatedly changed the date over the course of pre- trial depositions. Most importantly, he could not be sure which port was installed in the speakers he sent to Davies. He admitted that any speaker shipped after April of 1988 should have contained a long (non- elliptical) port. Townshend has no documents or other evidence to corroborate his testimony regarding the shipment to Davies, and most of his records relating to the several versions of the Glastonbury II were lost in a flood in Malta.

Mr. Davies testified that he received the Glastonbury II speakers from Townshend sometime in the middle of 1988. Davies has no records documenting his receipt of the speakers. At some time during 1990, Townshend sent Davies replacement ports for the speakers. These replacement ports were yet another design, called a tractrix. Davies testified that he personally replaced the original ports when he received the tractrix ports, but

could not say exactly what the original ports looked like. All he could recall is that the replacement ports were shorter than the ones he pulled out. Davies discarded the original ports.

The testimony on the Glastonbury II was rife with uncertainty and inconsistencies. I find that there is no credible evidence that Mr. Townshend shipped Mr. Davies' speakers containing an elliptical port tube during the relevant time period. Moreover, even if one assumed that the speakers shipped to Davies contained the "short form" Glastonbury II, JBL did not prove by clear and convincing evidence that even the "short form" Glastonbury II qualifies as prior art under § 102(b). Because of the connecting piece in the center, which was at least originally designed to adjust the two ends, it is unclear whether the short form port was an ellipse having a major diameter. On that point, Bose introduced evidence that the "short form" Glastonbury II model recovered from Mr. Townshend's friend's storage unit has a slightly flattened center section. (Exh. 607). This deviation would prevent the short form Glastonbury II from satisfying each element of claim 1 of the '721 invention. *See Scaltech,* 178 F.3d at 1383.

JBL also offered evidence of a "public use" and/or "offer to sell" of Davies' set of Glastonbury II speakers. According to Davies and Townshend, sometime at the end of 1998, they transported Davies' Glastonbury II's to the home of a Mr. Rick Roberts, the proprietor of a Hi-Fi store, and demonstrated them. But since neither Townshend nor Davies was sure of the structure of the port in Davies' speakers at that time, it was not clearly established which version of the Glastonbury II Townshend was trying to sell to Roberts. This demonstration does not bolster JBL's anticipation claim.

In short, I find the entire Glastonbury II line of testimony and evidence to be unreliable. I accordingly reject JBL's § 102(b) challenge.

2. Obviousness

JBL's second challenge to the validity of the '721 patent is that its subject matter was obvious, as defined by 35 U.S.C. § 103(a):

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

Obviousness under § 103 is a legal conclusion based on underlying factual inquiries, including: a) the scope and content of the prior art; b) the level of ordinary skill in the art; c) the differences between the claimed invention and the prior art; and d) objective evidence of nonobviousness. *See Graham v. John Deere Co.*, 383 U.S. 1, 15, 86 S.Ct. 684, 15 L.Ed.2d 545 (1966).

When making an obviousness analysis based on prior art teachings, reviewing courts must not fall prey to a "hindsight syndrome," reasoning backward from the teaching of the patent itself. *See In re Kotzab*, 217 F.3d 1365, 1369 (Fed. Cir. 2000). According to the Federal Circuit, "the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." *In re Gartside*, 203 F.3d 1305, 1319 (Fed. Cir. 2000); *see also B.F. Goodrich Co. v. Aircraft Braking Sys.*

Corp., 72 F.3d 1577, 1582 (Fed. Cir. 1996). In other words, something in the prior art, considered as a whole, must "suggest the desirability, and thus the obviousness, of making the combination" of different elements to create the invention. *Fromson v. Advance Offset Plate, Inc.*, 755 F.2d 1549, 1556 (Fed. Cir. 1985) (citing *Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick*, 730 F.2d 1452, 221 U.S.P.Q. 481, 488 (Fed. Cir. 1984)).

a. *The Prior Art; Comparison to the '721 Patent*

The term "prior art" for purposes of obviousness refers to the types of art enumerated in 35 U.S.C. § 102. *See OddzOn Prods. v. Just Toys, Inc.*, 122 F.3d 1396, 1403 (Fed. Cir. 1997). Holding that prior art for purposes of section 103 includes art of subsections 102(a), (b), (e), (f), and (g), the *OddzOn* court explained that these subsections "relate to knowledge manifested by acts that are essentially public." *Id.* at 1402. Subsections (a) and (b) relate to public knowledge or use, or prior patents and printed publications. *See id.*

JBL offered evidence of several pieces of prior art relating to loudspeaker porting and fluid flow design which it claims render the '721 patent invalid for obviousness. These include: the Laupman patent; the Furukawa patent; the KEF 104/2 loudspeaker; the International Organization for Standardization's International Standard 5167 ("ISO 5167") relating to fluid flow; the Akimichi patent; and the Townshend Glastonbury II speakers and brochures. I will address each of these references briefly.

Both the Laupman and Furukawa references were considered by the PTO Examiner during prosecution of the '721 patent. This makes their utility in an obviousness analysis even more challenging for JBL. *See Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1467 (Fed. Cir. 1990) (noting that the burden of showing patent

invalidity "is especially difficult when the prior art was before the PTO examiner during prosecution of the application.")

Laupman/Furukawa. Neither Laupman nor Furukawa discloses a port with a boundary defined by an ellipse. The Laupman patent discloses a loudspeaker enclosure with a port tube having smoothly flared input and output ends; however, the port contains a straight center section and straight sidewalls. In addition, one embodiment depicted in the Laupman reference suggests removing the curved bottom portion of the port and replacing it with a flat plane, which would result in a port with three flat sides. This teaches away from using an elliptical port boundary.

The Furukawa reference discloses a port with a flat, cylindrical center section. While the input and output ends of Furukawa are smoothly flared, the Furukawa port is not smoothly flared throughout, nor does it have a continuous decrease in cross-section. Bose was forced to revise its patent claim to avoid a prior art rejection based on Furukawa. *See Bose Corp. v. JBL, Inc.*, 98 F.Supp.2d at 90.

KEF 104/2. The KEF 104/2 loudspeaker is the product of a British audio company that sold speakers in the United States in the late 1980's and early 1990's. It contains a port with a circular shape. One of the designers of the KEF 104/2, Laurie Fincham, testified at trial that his design was aimed at reducing turbulence, and that he chose a curved port to achieve that goal. But a laser scan and mechanical drawing of the KEF 104/2 demonstrates it contains a straight tangent on its boundary that constitutes approximately 20-25% of the total length of the port. (Exh. 584; 584A). JBL argues that the straight tangent section is not part of the boundary between the acoustic mass and the inside

volume because the straight tangent section is within the loud speaker wall. Nonetheless, looking at the KEF 104/2, I am not persuaded that it would have been obvious to one of ordinary skill in the art to stretch the circular section to create an ellipse.

ISO 5167. Formally, the ISO reference is International Standard 5167, entitled "Measurement of fluid flow by means of orifice plates, nozzles, and venturi tubes inserted in circular cross-section conduits running full." (Exh. 585) JBL claims that the ISO article, which is not about a port tube but rather about fluid flow, rendered the '721 invention obvious. The ISO reference was before the PTO Examiner; the sketch of the curved duct and a citation to the ISO reference were contained in the textbook on fluid mechanics submitted to the PTO Office during prosecution. (See Exh. 1, "OTHER PUBLICATIONS" section on title page). The ISO reference does not disclose a port, or a loudspeaker enclosure, but discloses an inlet nozzle[11] for measuring fluid flow. Moreover, the ISO reference dealt with uni-directional fluid flow, from left to right, as opposed to the bi-directional fluid flow in a port tube. The ISO reference also indicates that the "throat" of the nozzle, leading to the outlet end, should be cylindrical. The PTO examiner found the '721 invention patentable, even with the benefit of the ISO reference accompanying the Furukawa and Laupman prior art.

Akimichi. The Akimichi reference, Japanese Patent 58,121,895, discloses a bass reflex loudspeaker having a "small space 9," which is used in one of the disclosed embodiments to couple the inside volume of the loudspeaker to the outside. What defendants call the

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[11] A "nozzle" is a device though which fluid flows, consisting of a convergent inlet portion connected to a cylindrical portion called the "throat."

Akimichi "port" is built into the wall of the loud speaker. The "small space 9" is in a "Venturi shape,"[12] which Mr. Button described as elliptical. The "small space 9" looks, at least in one embodiment, to be somewhat elliptical. (See Exh. 583, p. 3, Figure 13). As Mr. O'Connell described the Akimichi "small space 9" structure, Akimichi's design actually serves to dissipate acoustic energy that would otherwise be available to create sound in a room. Mr. O'Connell thus used the term "lossy" to describe the "small space 9," meaning that there is a loss of energy output. According to O'Connell, the "small space 9" actually causes turbulence which in turn creates (rather than reduces) port noise. He believes that the port is actually "space 8." Mr. Button disputed Mr. O'Connell's interpretation of the "small space 9," insisting that the patent nowhere indicates that the "small space 9" is lossy. Button insisted that the patent describes the function of the "small space 9" as "the essence of creating a Helmholtz resonance." In other words, Button testified that the "small space 9" performs the functions of the port as defined in the '721 patent.

While the testimony describing the Akimichi structure was conflicting (not to mention somewhat baffling) on this point, the patent describes the "air resistance due to the Venturi effect" created by the "small space 9." (Exh. 583 at 2, ¶ 9). Moreover, the patent offers several examples of shapes which could form these "small spaces," only one of which resembles an ellipse. The patent further explains that the key to obtaining this "Venturi effect" is to have a small space that "includes an arbitrary place with reduced diameter." (*Id.* at ¶ 13). Mr. Button acknowledged that,

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[12] A "Venturi" refers to a short tube with a tapering constriction in the middle that causes an increase in the velocity of flow of a fluid and a corresponding decrease in fluid pressure. It is used for measuring fluid flow.

as described in the patent, the narrowest part of a "small space 9" can be at any arbitrary place.

The Akimichi patent caused chuffing in my head because the translation and diagrams were so difficult to decipher. I found support for the hypotheses of both Button and O'Connell in the language of the patent. But based on the testimony and the descriptions contained in the patent itself, the defendant has not provided clear and convincing evidence that the Akimichi reference discloses an elliptical port tube. Most significantly, it does not teach toward the ellipse shape for the purpose of reducing turbulence and port noise within a loudspeaker. To the extent the "small space 9" actually creates turbulence and dissipates acoustic energy, it teaches away from the invention of the '721 patent. To the extent its function was to create a Helmholtz resonance, it does not teach toward the use of an ellipse to reduce turbulence or eliminate port noise.

Glastonbury II. Pushing on, we come to JBL's final prior art reference offered in support of its obviousness claim: an old friend, the Glastonbury II. Given the dead-on-arrival line of inquiry regarding whether, when, and how Mr. Townshend sold or demonstrated his "short form" Glastonbury II port (which at least approximates the ellipse shape) in the United States, I find that the "short form" Glastonbury II is not prior art to be considered under an obviousness analysis because it is not prior art under § 102. *See OddzOn Prods.*, 122 F.3d at 1402 (reasoning that prior art to be used in a § 103 analysis must qualify under one of the subsections of § 102).

As for the longer, more cylindrical Glastonbury II port, it adds little to an obviousness analysis, even if included in the category of prior art (assuming, though it was not proven by clear and convincing evidence, that the speakers shipped to Mr. Davies contained the long form

Glastonbury II). This is because the long form Glastonbury II is so similar to Furukawa's cylindrical design.

I consider the incarnations of Glastonbury II relevant only to the extent that they are probative on the issue of level of skill in the art of loudspeaker design at the time of the invention. *See Orthopedic Equip. Co., Inc. v. United States*, 702 F.2d 1005, 1012 (Fed. Cir. 1983) (stating that evidence offered in support of § 102 defenses, though insufficient for that purpose, may still be probative on level of skill in the art).

JBL also offers, as prior art, brochures of the Glastonbury II. Under § 102(b), a printed publication qualifies as prior art, regardless of its origin. Townshend produced a brochure of the Glastonbury II, and claims he distributed that brochure in the United States. However, it is unclear which port was contained in the speaker advertised in that brochure. The photograph in the brochure is that of the original speaker cabinet which Townshend claims housed the short form port, but the brochure specifications reflect that the depth of the speaker is 18 inches; this would indicate that the brochure described the speaker with the long form of the port. The brochure itself does not indicate the shape of the port, but says simply: "the forward facing port is aerodynamically flared both inside and out to eliminate 'chuffing.'" (Exh. 576). Suffice it to say that, given the discrepancies about which port was depicted in the brochure, it, too, is of limited usefulness in an obviousness analysis.

In sum, I find that none of the prior art references discloses an elliptical port for use within a loudspeaker. Taken as a whole, the prior art does not contain a motivation or suggestion to make modifications, or to adapt various elements of different references, in order to create the invention of the ' 721 patent.

b. *Level of Ordinary Skill in the Art*

Factors which are considered in determining the level of ordinary skill in a given art include: "the various prior art approaches employed, the types of problems encountered in the art, the rapidity with which innovations are made, the sophistication of the technology involved, and the educational background of those actively working in the field." *Orthopedic Equip.*, 702 F.2d at 1011. I have already reviewed the prior art, and as to the remaining considerations, the parties do not meaningfully dispute the level of ordinary skill in the art of loudspeaker enclosure design during the relevant time period. Their dispute lies in the ultimate question of whether a person of ordinary skill would have found the '721 invention obvious.

In terms of educational background and technical sophistication, I find that one of ordinary skill in the art during the relevant time period would be a person with a bachelor of science degree in either electrical engineering, physics, mechanical engineering, or possibly acoustics. That person would be familiar with aerodynamics, fluid flow mechanics, and acoustics, and would have worked as a loudspeaker designer for two to three years, having kept up with current literature and trade magazines to keep abreast of new developments.

As stated earlier, the short Glastonbury II is relevant to prove the level of ordinary skill in the art, even if it is not prior art for purposes of section 103. Specifically, I consider the following litany of facts. At some point in the 1980's, Mr. Townshend developed a double-flared port constructed of two half-pieces joined with a sleeve. Townshend was able to tune the port by moving the two halves. Although he described the Glastonbury II port tube as adjustable to magazine reviewers, Mr. Townshend testified that, in practice, he did not move the two halves

apart from one another, and that the resulting profile of the port was "very close" to a mathematical ellipse. Townshend acknowledged that there may have been a slightly flattened portion due to the manufacturing process.

Mr. Townshend said that he determined that an ellipse should be the shape of the port tube based on his personal experience with sailing a Hobie Cat and as an engineer. Evidence of a contemporaneous independent development is relevant to obviousness as a secondary consideration. *See Monarch Knitting Machinery Corp. v. Sulzer Morat GmbH,* 139 F.3d 877, 883-84 (Fed. Cir. 1998).

Townshend then changed the design of his speaker in response to customer complaints that it was too large; by reducing the size of the speaker, he had to lengthen the pipe connecting the two flared ends of his port. Townshend claims he sold the Glastonbury II with the "long port" from late 1987 to 1989. This "long port" has a straight cylindrical center section reminiscent of the Furukawa prior art. Notably, Townshend changed the port design yet again, moving further away from an ellipse shape to a "tractrix" shape with a long cylindrical section.

c. *Objective Evidence of Nonobviousness*

Bose appropriately offered objective evidence of nonobviousness. Evidence such as "commercial success, copying, long felt need, is relevant, and when present must be considered." *Glaverbel Societe Anonyme v. Northlake Marketing & Supply, Inc.,* 45 F.3d 1550, 1555 (Fed. Cir. 1995) (citing *Stratoflex, Inc. v. Aeroquip Corp.,* 713 F.2d 1530, 1538-39 (Fed. Cir. 1983)).

Commercial Success. Bose did experience great commercial success with its products incorporating the invention of the '721 patent. Bose's sales of Acoustimass and Lifestyle products increased significantly--over one

third--in the year after the patented invention was introduced in 1991. I will address the commercial success issues in more detail in my findings on damages, but I find that this factor does weigh in favor of nonobviousness.

Copying. The documents prepared by Mr. Devantier certainly suggest that JBL was looking to its competitor Bose throughout the design and engineering of its loudspeakers. JBL admittedly had on site a Bose Acoustimass 5 bass module which it was using for "benchmarking" purposes. However, I found the testimony of JBL engineer Ms. Alexander to be very credible. I find that, as to the elliptical port tube design, JBL engineers were working independently to develop a solution to the port noise problem. While I do not find that JBL copied the port tube itself, its adulation of the Acoustimass 5 bass module is the best evidence of the extent of its commercial success.

Long Felt but Unmet Need. The dilemma of port noise in loudspeakers was a long-felt problem within the industry. Especially since the advent of the bass reflex and band pass enclosures, the port plays a much more dominant role. Mr. Fincham of KEF testified that in the 1984-85 time frame, KEF was concerned with port noise due to turbulence as it designed its 104/2 loudspeaker enclosure. Moreover, the Furukawa patent, filed in 1989, is directed to the problem of port noise, and suggests a cylindrical port tube, lined with felt, as a solution. (Exh. 258). Mr. O'Connell from Bose, and Mr. Devantier and Mr. Button from JBL, agreed that the impetus to eliminate port noise, as well as other undesirable acoustic phenomena, was industry-wide.

d. *Hypothetical Claim Analysis*

Defendant urges the Court to use a methodology known as the "hypothetical claim analysis" to aid in determining whether the prior art prevents application of

the doctrine of equivalents to a particular claim. *See Marquip, Inc. v. Fosber America, Inc.*, 198 F.3d 1363, 1367 (Fed. Cir. 1999). The Federal Circuit explained the two part inquiry with the following illustration:

> As a helpful illustration of the operation of this limitation on the doctrine of equivalents, this court visualized a hypothetical patent claim, sufficient in scope to cover literally the accused device. *See id.* [*Wilson Sporting Goods Co. v. David Geoffrey & Associates*, 904 F.2d 677 (Fed. Cir. 1990)]; *Key Mfg. Group, Inc. v. Microdot, Inc.*, 925 F.2d 1444, 1449, 17 U.S.P.Q.2d 1806, 1810 (Fed. Cir. 1991) ("While not obligatory in every doctrine of equivalents determination, the hypothetical claim rationale ... helps define the limits imposed by prior art on the range of equivalents."). Then this court examined whether the PTO would have allowed that hypothetical claim over the prior art at the time of invention. *See Wilson Sporting Goods*, 904 F.2d at 684. If the claim would have been allowed, then prior art is not a bar to infringement by equivalents. If the claim would not have been allowed, prior art bars a finding of infringement.

Id.

In particular, defendant points to KEF 104/2, Akimichi, and the Glastonbury II short elliptical port and claims that any hypothetical claim that would cover its Linear A and exponential curves would not have been patentable over this prior art. In examining the prior art, I conclude that the PTO would have allowed a hypothetical claim, for example, to a "substantially elliptical" port that is flared throughout and has a continuously decreasing cross-section. Such a claim encompasses the Linear A and the exponential curves, but does not sweep in the prior art. For the reasons stated

above, there is no evidence that JBL's curves, as used in the ports, were obvious in light of the three cited prior art references.

e. *Conclusion*

Although no one reference describes the claimed invention, JBL argues that the prior art taken as a whole contained a suggestion to combine the references. "If the invention is different from what is disclosed in one reference, but the differences are such that combination with another reference would lead to what is claimed, the obviousness question then requires inquiry into whether there is reason, suggestion, or motivation to make that combination." *Pro-Mold and Tool Co. v. Great Lakes Plastics, Inc.*, 75 F.3d 1568, 1573 (Fed. Cir. 1996). Such a suggestion may come: (1) "expressly from the references themselves;" (2) "from knowledge of those skilled in the art that certain references, or disclosures in the references, are known to be of special interest or importance in the particular field;" or (3) "from the nature of a problem to be solved, leading inventors to look to references relating to possible solutions to that problem." *Id.* (citations omitted).

JBL is correct that the Court should consider the prior art as a whole, rather than simply piecemeal. Considered as a whole, however, I conclude that the prior art does not suggest the combination of various elements to form an elliptical port tube. The prior art references do not suggest that an ellipse would solve the problem of air turbulence at high volumes that causes port noise.

Based on all the evidence, including the level of ordinary skill in the art, the prior art, and the objective factors, I find that the invention of the '721 patent would not have been obvious to one of ordinary skill in the art at the time the invention was made. The most compelling evidence of obviousness, is the short Glastonbury II port, which was designed to be elliptical (though it likely had a

flat section because of the manufacturing process) because it suggests a contemporaneous invention. But Mr. Townshend changed his port design repeatedly, moving in the direction from short to long, and then finally to a tractrix shape with a cylindrical section. This elongation demonstrates that the ellipse design was not an obvious means to reduce port noise. Finally, the objective considerations (most significantly commercial success) weigh in favor of nonobviousness.

E. Willfulness

Bose claims that JBL willfully infringed the '721 patent. "Whether infringement is willful is a question of fact, and must be established by clear and convincing evidence." *See Comark Communications, Inc. v. Harris Corp.*, 156 F.3d 1182, 1190 (Fed. Cir. 1998). A court looks to the totality of the circumstances, and the inquiry is whether the infringer acted in disregard of the patent, and "had no reasonable basis for believing it had a right to do the acts." *American Med. Sys., Inc. v. Medical Eng'g Corp.*, 6 F.3d1523, 1530 (Fed. Cir. 1993) (quoting *Stickle v. Heublein, Inc.*, 716 F.2d 1550, 1565 (Fed. Cir. 1983)). Courts are also required to consider any ameliorating or mitigating circumstances. *See id.*

Generally, "a potential infringer with actual notice of another's patent has an affirmative duty of care that usually requires the potential infringer to obtain competent legal advice before engaging in any activity that could infringe another's patent rights." *Comark*, 156 F.3d at 1190; *see also Electro Med. Sys., S.A. v. Cooper Life Sciences, Inc.*, 34 F.3d 1048, 1056 (Fed. Cir. 1994); *Minnesota Mining & Mfg. Co. v. Johnson & Johnson Orthopaedics, Inc., Minnesota Mining & Mfg. Co. v. Johnson & Johnson Orthopaedics, Inc.*, 976 F.2d 1559, 1579 (Fed. Cir. 1992). However, the fact that an infringer obtained an opinion of counsel, or did not do so, is not

determinative on the issue of willfulness. *See Kloster Speedsteel, AB v. Crucible, Inc.*, 793 F.2d 1565, 1579 (Fed. Cir. 1986). Other factors to consider include: any intent to copy by the infringer; the infringer's investigation upon notice of the patent; and whether the infringer acted in good faith as a party to the litigation. *See Delta-X Corp. v. Baker Hughes Prod. Tools, Inc.*, 984 F.2d 410, 413 (Fed. Cir. 1993) (finding that an infringer may generally avoid enhanced damages for willfulness where it makes "a meritorious good faith defense and substantial challenge to infringement."); *Kalman v. Berlyn Corp.*, 914 F.2d 1473, 1483-84 (Fed. Cir. 1990).

The question of willfulness is a close call. Two factors militate in favor of willfulness, one against. First, JBL continued to sell clearly infringing products after receiving notice of the issuance of the patent. JBL received actual notice of the patent on the date it issued, February 2, 1998; Bose filed suit against JBL on that same day. Mr. Toole of JBL testified that, upon learning of the patent, JBL identified which of its products infringed and considered retrofitting those products with non-elliptical ports. Ultimately, JBL decided against the retrofit. Although JBL stopped manufacturing port tubes with elliptical boundaries, and stopped production on a product line, it continued to sell products with the infringing ports from its existing stock. After the re-design, JBL did not seek an opinion of counsel on whether the Linear A and exponential ports would infringe the patent. JBL did consult its attorneys in the context of this litigation, and understood that counsel would raise defenses to the suit, but concedes that it is not relying upon the opinion of counsel as a basis to avoid a finding of willfulness.

Second, the laser scans of the Linear A and exponential ports demonstrate they are virtually identical, and this raises the suspicion there was no genuine effort

to avoid infringement. However, Bose did describe the port with a precise mathematical formula (ellipse with a major diameter) which invited the illusory hope that a slight deviation in the formula would squeak by infringement.

The factor that ultimately saves JBL is that it defended the suit in good faith, and raised a substantial, though ultimately unsuccessful, defense of obviousness under 35 U.S.C. § 103. JBL held a good faith belief the prior art taken as a whole suggested the invention. I agree with JBL that this was not a pioneer patent. The concept of an ellipse to deal with air turbulence may not have come from prior art in the loudspeaker world, but it was readily derived from jet engines and sail boats. This good faith reliance on a defense of obviousness weighs heavily against a finding of willfulness.

Though it is a close call, I find that JBL's infringement was not willful.

F. Damages

A patent owner is awarded damages "adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer." 35 U.S.C. § 284. When a patentee can prove lost profits, he may recover them; otherwise, he is entitled to a reasonable royalty. *See Panduit Corp. v. Stahlin Bros. Fibre Works, Inc.*, 575 F.2d 1152, 1157 (6th Cir.1978). When lost profits can be shown for some sales, but not others, the court may award lost profits for those sales shown deserving and a reasonable royalty for the remaining sales. *See Amstar Corp. v. Envirotech Corp.*, 823 F.2d 1538, 1543-44 (Fed. Cir. 1987).

Altogether, there are 45 infringing speaker products. The total number of infringing speakers sold was 278,498, which generated sales of $55,992,337. There are ten JBL

products for which Bose contends it deserves lost profits for sales JBL made during the infringement period;[13] Bose seeks a reasonable royalty on the remaining sales of infringing JBL products. At trial, the parties presented evidence on damages for the period from February 3, 1998 through March 2000, which will be deemed "the infringement period" for the Court's determination of damages at this stage.[14]

1. Lost Profits

While there is no exclusive standard by which a patentee establishes lost profits, the parties both adopted one acceptable approach, the *Panduit* test. Under that standard, a patentee seeking lost profits damages must establish the following things: 1) demand for the patented product; 2) absence of acceptable non-infringing substitutes; 3) manufacturing and marketing capability to exploit the demand; and 4) the amount of profit it would have made. *See Panduit,* 575 F.2d at 1158; *Kaufman Co. v. Lantech, Inc.,* 926 F.2d 1136, 1140-41 (Fed. Cir. 1991). Bose must prove that there was a reasonable probability that, but for the infringement, it would have made JBL's sales. *See Grain Processing Corp. v. American Maize-Prods. Co.,* 185 F.3d 1341, 1349 (Fed. Cir. 1999); *State Indus., Inc. v. Mor-Flo Indus., Inc.,* 883 F.2d 1573, 1577 (Fed. Cir. 1989).

a. *Demand for the Patented Product*

While all the witnesses conceded that it is difficult to quantify the contributions of the elliptical port tube to the

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[13] The JBL products for which Bose seeks lost profits damages are: SCS 110; SCS 115; SCS 120; SCS 125; ESC 300 (and 300 "B"); ESC 333; ESC 350; ESC 550; and Festival 80.

[14] The calculations will be adjusted to account for a full infringement period from February 3, 1998 to the date of this Court's judgment.

success of the Acoustimass and Lifestyle products, I find that the '721 invention contributed substantially to the increased demand for the Bose products in which it was incorporated.

There was substantial evidence that the patented invention improved the performance of the speakers at issue. Both Bose's marketing executive, Mr. Coley, and JBL's marketing executive, Mr. Harary, agreed that consumers value the performance of loudspeakers above all else in making a purchasing decision. Mr. Coley established that the '721 invention is tied closely to the overall performance of the Bose speakers, since the elliptically flared port tube eliminated the port noise and "chuffing" that interfered with the quality of the bass tones produced. Mr. Harary of JBL acknowledged that improved bass performance was a prerequisite to his decision to go forward with manufacturing and selling the MUSIC 10 and MUSIC 20. Mr. Harary rejected an initial redesign that did not fully address concerns with the bass noise.

To be sure, many other improvements were added to the Acoustimass 5 that also contributed to its success. Bose acknowledged this. Also, timing was a factor. Plaintiff began offering the AMS Series II at a time when the overall market was experiencing growth. However, the resolution of the port noise problem was integral to some of these other improvements. The resolution of the port noise problem opened the way for Bose's new three-chambered design, which allowed the bass module to cover a wider range of frequencies. The '721 invention also allowed Bose to make additional improvements, including reducing the size of the "cube" satellite speakers to produce a more aesthetically pleasing product. On this point, Mr. Toole of JBL conceded that consumers demand

nearly "invisible loudspeakers, or at least very good looking ones."

Bose made efforts to market the benefits of the elliptical port to its customers. As was made abundantly clear by a review of Bose's brochures, product guides, in-store displays and advertisements, Bose highlighted, among other product features, the benefits of the elliptical port. Reviews in industry magazines of various Acoustimass and Lifestyle products focus extensively on the sound quality of the bass module. Moreover, as Mr. Coley and Bose's damages expert, Mr. Christopher Barry, testified, Bose's Acoustimass 5 experienced an approximately 33% increase in sales in the year following the introduction of the products containing the '721 invention. This is, at least, evidence of the demand for a product that offered enhanced bass quality.

JBL argues that there is no evidence (such as a customer survey) that the average customer purchased a loud speaker because of an elliptical port tube. This is an unfair way of framing the issue. Few purchasers of home electronics are aware of the design and function of each internal component, but by all accounts purchasers of high-end speaker systems value sound quality and performance above all else. Mr. Harary, Brand Manager of Infinity Systems, said it best: "[N]obody wants to buy something that sounds bad or makes weird noises."

In sum, I find that Bose produced sufficient, unrebutted evidence that the '721 invention contributed substantially to consumer demand and to overall sales of the Acoustimass and Lifestyle products.

b. *Substitutes in the market; the market share evidence*

As to the second *Panduit* factor, Bose does not deny that there were other players in the speaker market.

Instead, Bose relies on a "market share" theory, accepted by the Federal Circuit in *State Industries,* 883 F.2d at 1578, and introduced evidence that Bose would have picked up at least a *pro rata* share of JBL's sales of ten different infringing products. In *State Industries,* the district court had made the second *Panduit* item a "neutral factor" by allowing the patentee to establish its share of the market, and crediting it with its share of the infringer's sales. *See id.*

JBL objects to this approach, arguing--correctly--that the market share approach is not automatically applied, and that the patentee must still prove its market share and that it would have captured the infringing sales. *See Slimfold Mfg. Co. v. Kinkead Indus.*, 932 F.2d 1453, 1458 (Fed. Cir. 1991) (holding that a district court's refusal to award lost profits on a market share theory was not an abuse of discretion, where patentee did not establish that consumers specifically wanted a product with the advantages of the patent). To prove market share, plaintiffs must present "sound economic proof of the nature of the market and likely outcomes with infringement factored out of the economic picture." *Grain Processing,* 185 F.3d at 1351. The Federal Circuit explained the parameters of reconstructing a "but for" market as follows:

> By the same token, a fair and accurate reconstruction of the "but for" market also must take into account, where relevant, alternative actions the infringer foreseeably would have undertaken had he not infringed. Without the infringing product, a rational would-be infringer is likely to offer an acceptable noninfringing alternative, if available, to compete with the patent owner rather than leave the market altogether. The competitor in the "but for" marketplace is

> hardly likely to surrender its complete market share when faced with a patent, if it can compete in some other lawful manner. Moreover, only by comparing the patented invention to its next-best available alternative(s)-- regardless of whether the alternative(s) were actually produced and sold during the infringement--can the court discern the market value of the patent owner's exclusive right, and therefore his expected profit or reward, had the infringer's activities not prevented him from taking full economic advantage of this right. Thus, an accurate reconstruction of the hypothetical "but for" market takes into account any alternatives available to the infringer.

Id. at 1350-51 (citations omitted).

Mr. Harary testified that in the face of a high royalty rate, defendants would have tried various options, such as a cylindrical port, a passive radiator, or a sealed enclosure that does not contain a port tube at all. However, defendants have not shown that any of these substitutes would have produced an acceptable reduction in port noise. The proof-in-the-pudding is the evidence that as soon as JBL learned about the issuance of the patent, it attempted to design around it by creating a virtually indistinguishable curvature. Even prior to the issuance of the patent, JBL knew that the MUSIC 1 and MUSIC 2 were not competitive with the Acoustimass 5 because the bass was not good enough. The highest priority was to get a better subwoofer for MUSIC 2. The record is too scant on the availability of "acceptable" substitutes to be persuasive.

The ten infringing JBL products for which Bose seeks lost profits damages fall into two categories: 6-piece speaker systems, and "one brand shelf systems" (or "OBSS"). The 6-piece speaker systems consist of one bass

module, or subwoofer, and five satellite speakers which generate the higher frequency sounds. These systems are typically built and sold as a package by a single manufacturer. Bose claims that its Acoustimass 6 ("AM6") and Acoustimass 10 ("AM10") 6-piece systems compete directly with seven infringing JBL 6-piece systems: the SCS 110; SCS 115; SCS 120; SCS 125; ESC 300 (and 300 "B"); and ESC 333.

OBSS systems are a home theater product, which typically have, in addition to speakers, a central unit containing a CD player, an AM/FM tuner, "surround sound" technology,[15] and a remote control. The systems are packaged and sold by a single manufacturer or brand, hence the name. As to these products, Bose claims that its own Lifestyle 8 and Lifestyle 12 compete directly with the following infringing JBL OBSS systems: ESC 350; ESC 550; and Festival 80. The Lifestyle 8 and Lifestyle 12 come with: five satellite speakers; one bass module containing the patented invention; a remote control; and a central "music center" unit that contains a CD player, AM/FM tuner and surround sound electronics.

To show a reasonable probability that, but for the sale of JBL's infringing products, Bose would have picked up its market share of sales in these two categories, Bose relied on the testimony of Mr. Coley and Mr. Barry. Mr. Coley compared the features of the Bose 6-piece and OBSS systems with those of the infringing JBL counterparts, and opined that these Bose and JBL products competed directly with one another, were marketed in the same channels, had similar features and

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[15] "Surround sound" refers to technology which allows a home audio system to mimic the effect of sitting in a movie theater. It employs decoding technology, which takes various sound tracks from a movie and channels sound to the front, center, or rear speakers set up in the listener's living room.

benefits, and were priced similarly. Mr. Barry, who relied both on Mr. Coley's expertise in the field, as well as industry research, testified that Bose would have reaped its market share of profits in these two categories. Mr. Barry adopted price bands[16] developed by Mr. Coley for these two market segments; he also relied on information compiled by Intelect ASW, an independent industry research organization that provides sales information for particular categories of consumer products. Both Bose and JBL subscribe to Intelect's reports and use the data regularly in their businesses to track their market share in these two segments.[17] Intelect categorizes the 6-piece and OBSS systems as two separate segments of the home speaker market.

Given both parties' reliance on Intelect's analyses of the home speaker market, I find that the 6-piece systems and the OBSS systems represent two distinct segments of the home speaker market. The two companies advertise, promote, and market their products in the same channels of commerce, although Bose spends significantly more than JBL on advertising.

In response, JBL offered the testimony of Mr. Harary, who highlighted the differences between several of the

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[16] Coley offered the following price bands, based on his experience in the industry: for the six-piece speaker systems, 1) $250 to $750; and 2) $500 to $1,000; and for the OBSS systems, 1) $600-$1,500; and 2) $1,000 to $2,000.

[17] Counsel for JBL failed to object contemporaneously when Bose moved the Intelect raw data (Exh. 182) into evidence, but objected to Bose's reliance on that data in its post-trial submissions. While the transcript is not crystal clear on whether the Court admitted this exhibit, several succeeding exhibits (Exh. 361, 362, and 363) which were drawn from the Intelect data and which formed the basis for Mr. Barry's testimony on price segments and market share were later admitted without objection. *See* Tr. 8-104:10-20; Tr. 8-110:20-25; Tr. 8-111:1-10; Tr. 10-93:11-19.

Bose and JBL products, testified about other competitors in these market segments, and refuted Mr. Coley's "price bands" in these two categories of products, offering narrower price categories. For example, Mr. Coley used a price band of $250 to $750, suggesting that a consumer who initially set out to spend $250 on speakers would somehow be induced to spend three times that much. While this may be true for certain consumers, I find it is unrealistic as applied to others. Especially for those with a smaller acoustics budget (e.g. college students), such broad flexibility is unlikely. Similarly, Bose's OBSS price band of $600 to $1,500 is not only excessively broad, it also strangely overlaps with the $1,000 to $2,000 price band that both parties agreed was reasonable. Mr. Harary offered price bands that were narrow at the lower end, and broad at the higher end. Harary offered the following price bands: 1) under $199; 2) $250 to $399; 3) $399 to $499; 4) $499 to $799; 5) $800 to $1000; 6) $1000 to $2000. Because Mr. Harary's price bands are more realistic, I adopt them.

i. *6-piece speaker systems; comparison of price and features*

The following chart compares the prices of the six-piece systems at issue.

Bose Product	***Price***	***JBL Product***	***Price***
Acoustimass 6	$ 699	SCS 110	$599 - $699
		SCS 115	$799 - $899
Acoustimass 10	$1,099	SCS120	$1,000
		SCS125	$299 - $399
		ESC 300/300B	$999
		ESC 333	$799

On the basis of price alone, I find that the SCS 125, which was described as an "entry level" JBL product, does not compete with the higher-end and substantially more expensive AM6 and AM10. Using the same reasoning, I

find that the SCS 120 is not a competitor of the AM6. The SCS 120, priced initially at $1,000 is a significant "step up" from the AM6, whose average retail price was $608 per unit.

From here, the analysis turns to the features of each system. I find that the Bose AM6 and the JBL SCS 115 are different enough that Bose failed to establish a reasonable probability that a consumer buying one would purchase the other as a substitute. The JBL SCS 115 has a "powered" bass unit, which means that there is an amplifier contained in the subwoofer. The Bose AM6 (and its admitted competitor, the JBL SCS 110) are "passive" subwoofers, meaning they do not contain an amplifier. From a consumer perspective, the difference is as follows. While a purchaser of any of these systems would need to purchase a receiver to which the speakers attach, the SCS 115 offers an additional benefit because of its built-in amplifier. A consumer buying the SCS 115 could purchase a less expensive, less powerful receiver for her system, because the speakers' own amplifier will handle some of the output. Moreover, Mr. Harary credibly testified about the benefits, from an engineer's perspective, of having a built-in amplifier that maximizes speaker performance.

I further find that the JBL ESC 300/300B and the ESC 333, are not direct competitors of the AM6 or the AM10. These JBL products are known as "plug and play" systems, which means that they can be connected directly to a consumer's TV or VCR to produce surround sound. There is no need to have a receiver, because the amplifier, as well as a Dolby "surround sound" data processor, are built right into the subwoofer. The user can operate the system by pointing a remote control directly at the subwoofer. These features are not offered with the AM6 or the AM10.

Finally, JBL has conceded that the SCS 110 is a direct competitor of the Bose AM6, and that the SCS 120 is a direct competitor of the Bose AM10. While the price and feature similarities between these products would weigh in favor of a lost profits award, Bose submitted market share evidence based on price bands and product combinations that the Court finds unacceptable. Moreover, since Bose included powered 6-piece systems and "plug-and-play" systems in market share and lost profits calculations, I cannot rely on Mr. Barry's reports to determine what the appropriate calculations would be in the absence of these products that I find non-competing.

In sum, as to the 6-piece systems, I find that Bose did not adequately establish its true market share with respect to the type of products (such as JBL's SCS 110 and SCS 120) that actually compete with Bose's 6-piece unpowered speaker systems (the AM6 and AM10). With respect to these products, then, I will apply a reasonable royalty analysis.

ii. *One Brand Shelf Systems (OBSS); comparison of price and features*

Again, I begin with a snapshot price comparison of the products at issue.

Bose Product	***Price***	***JBL Product***	***Price***
Lifestyle 8	$1,300	ESC 350	$810
		ESC 350	$930
Lifestyle 12	$2,000	Festival 80	$1,500

Since both parties agreed that $1,000 - $2,000 represents a realistic price band, I find that the product mappings offered by Bose with respect to lost profits on the Festival 80 are valid. As to the ESC 350 and ESC 550, however, Mr. Barry's calculations rest on a market share analysis the Court cannot accept. Once again, I find that Mr. Coley's price band of $600 to $1,500 is excessively

broad and sweeps in products that would not realistically compete head-on with the products at issue. Essentially, Bose tried to reconstruct two different markets for the OBSS systems, including a high-end band that would sweep in JBL's Festival 80, and a lower-end band that would sweep in the ESC 350 and ESC 550. For the lower-end band, Bose included several OBSS systems from competing companies priced in the $600 and $700 range, and asks the Court to accept that those products compete with its Lifestyle 8, priced at $1,300. I decline to do so. Although the JBL ESC 350 and ESC 550 may, in fact, compete with the Lifestyle 8, Bose's aggressive price bands used to calculate its market share defeat its claim to lost profits on these products.

c. *Manufacturing and Marketing Capacity*

JBL stipulated that Bose had the manufacturing capacity to make the additional Acoustimass and Lifestyle products that would have been sold absent JBL's infringement. Bose presented undisputed evidence that it had the marketing capacity to handle additional sales as well.

d. *Quantification of Lost Profits*

JBL did not dispute the methodology used by Mr. Barry in calculating Bose's lost profits, and the Court credits the testimony of Mr. Barry in this regard. JBL's disputes lay in the product comparisons as well as the appropriate price bands.

Mr. Barry determined Bose's lost profits in the following manner: a) he determined the number of units eligible for lost profits based on Bose's market share in the appropriate price band; b) he calculated Bose's operating profit for each of the AM6, AM10, Lifestyle 8, and Lifestyle 12 products during the infringement period; c) he determined Bose's incremental profit per product using

the percentages of fixed and variable costs supplied by Bose's Vice- President of Finance, Mr. Joseph Burchill; d) he calculated Bose's total lost profits by multiplying Bose's operating profit per product by the number of these units Bose would have sold absent JBL's infringing products in the marketplace, using the product mappings set by Mr. Coley and the applicable market share percentage.

In sum, I find that, in the absence of JBL's infringing Festival 80, Bose would have made its market share of sales of the Lifestyle 8 and Lifestyle 12. Damages for the remaining infringing JBL products for which I find Bose did not establish it was entitled to lost profits, namely: the SCS 110; SCS 115; SCS 120; SCS 125; ESC300/300B; ESC 333; ESC 350 and ESC 550 will be calculated according to a reasonable royalty, as set forth below.

2. Reasonable Royalty

A patentee is entitled to no less than a reasonable royalty on an infringer's sales for which that patentee has not established entitlement to lost profits. *See* 35 U.S.C. § 284 (1988); *Hanson v. Alpine Valley Ski Area, Inc.*, 718 F.2d 1075, 1077 (Fed. Cir. 1983). A reasonable royalty is the amount that a person who wishes to manufacture, use, or sell a patented item would be willing to pay as a royalty while still being able to make a reasonable profit. *See Trans-World Mfg. Corp. v. Al Nyman & Sons,* 750 F.2d 1552, 1568 (Fed. Cir. 1984).

The royalty calculation is a two-step process: 1) determination of a reasonable compensation base, i.e. the total value of the infringing items on which the patentee is entitled to royalty payments; and 2) determination of a reasonable royalty rate to apply to that compensation base. *See Standard Mfg. Co. v. United States,* 42 Fed. Cl. 748, 759 (Fed.Cl.1999).

a. *Royalty Base*

Using the "entire market value" rule, the Court considers the value of the entire product, even if it contains several features, where the patent-related feature is the basis for consumer demand. *See Fonar Corp. v. General Elec. Co.*, 107 F.3d 1543, 1552 (Fed. Cir. 1997) (allowing recovery based on the value of an entire MRI machine, where patented multi-angle imaging feature was shown to be linked to consumer demand); *Rite-Hite Corp. v. Kelley Co.*, 56 F.3d 1538, 1549 (Fed. Cir. 1995)(holding that "the entire market value rule permits recovery of damages based on the value of a patentee's entire apparatus containing several features when the patent related feature is the 'basis for customer demand'").

JBL's damages expert, Mr. Michael Keller, argued that the royalty base should be purely the manufacturing cost of the elliptical port, plus the speaker enclosure housing it. Alternatively, Keller opined that the royalty base should be the manufacturing cost of the entire product, less any associated "electronics." However, Mr. Keller did not know of any consumer electronics licenses wherein manufacturing cost was used as a royalty rate, and he personally has used the manufacturing cost of a product in only three to six of the seventy-five licenses he has negotiated.

As outlined above in the lost profits analysis, Bose produced sufficient unrebutted evidence that the elliptical port design, which produced considerably improved bass performance at high volume levels, shared a substantial nexus with the demand for the products incorporating it. I find that the elliptical port tube works with the other components as a single functioning unit, in order to produce desirable bass performance, which both parties agree is of primary importance to consumers. The '721 invention is an integral part of the speaker units sold by

Bose, and the port is an integral part of the speaker systems sold by JBL. Both companies devoted substantial resources to port design, because of its close connection to the product's performance. I found credible Mr. Coley's testimony regarding how the '721 invention worked in tandem with other design features and improvements in the Bose products.

As for Mr. Keller's opinion that the royalty base should not include the cost of accompanying "electronics", the evidence showed that, with the exception of the Festival 80 product, the defendants sell all of their infringing 6-piece and OBSS products as complete systems. Similarly, Bose sells all of its Acoustimass and Lifestyle products as systems, not as separate pieces.

I find that the entire value of the product is the appropriate basis for calculating the royalty base. Given my findings as to lost profits damages, Bose's proffered royalty base encompassing JBL products sold during the infringement period will be adjusted upward to include the JBL products for which I found Bose had not established it was entitled to lost profits.

b. *Royalty Rate*

To determine a reasonable royalty rate, a court looks first for an established royalty applicable to the patent at issue. *See Trell v. Marlee Elecs. Corp.*, 912 F.2d 1443, 1445 (Fed. Cir. 1990). Here, the parties agree that none exists. Lacking an established royalty rate, the Court must retroactively construct a hypothetical "arms-length" negotiation between a willing licensor and willing licensee to determine the royalty rate upon which the parties would have agreed. *See TWM Mfg. Co. v. Dura Corp.*, 789 F.2d 895, 898-899 (Fed. Cir. 1986). That negotiation is considered to have taken place on the date of first infringement by the infringer. *See State Indus.*, 883 F.2d at 1580. Here, to simulate the "willing licensor/willing

licensee" negotiation, both parties used a fifteen-factor analysis outlined in *Georgia-Pacific Corp. v. United States Plywood Corp.*, 318 F. Supp. 1116 (S.D.N.Y.1970), *modified and aff'd*, 446 F.2d 295 (2d Cir.1971).

Although both parties' experts agreed that the *Georgia-Pacific* factors are a standard approach to determining a royalty rate, JBL's Mr. Keller insisted that the baseline starting point for that royalty rate is zero. Mr. Barry testified that, applying the "25%/75%" rule that apportions 25% of the licensee's profit margin to the licensor, an appropriate baseline starting point would be 5%, because, on average, JBL's profit margin on the infringing products was approximately 20%. Adding an additional 4% to reflect the *Georgia-Pacific* analysis, Mr. Barry calculated a royalty rate of 9%. Mr. Keller also found that the *Georgia-Pacific* factors would lead to a 4% increase, but argued that the 25%/75% analysis was misplaced and that the appropriate starting rate was zero.

I turn to the *Georgia-Pacific* factors before addressing the other contentions.

i. **Royalties that a patentee receives for the patent in suit.** Since Bose has not licensed the '721 patent technology, both parties agree this factor is not applicable to this case.

ii. **Rates licensee pays for use of other comparable patents.** Since JBL does not have any patent licenses for port tubes or subwoofers, this factor is also not applicable.

iii. **Nature and scope of the license.** This factor looks at whether a license is, for example, exclusive or contains territory restrictions. Plaintiff claims this factor is not applicable. Defendants contend that this factor leads to a lower royalty rate because the license agreement would have been a simple non-exclusive

exercise without any technology transfer or trademark rights. I agree with defendants.

iv. The licensor's established policy regarding licensing of its technology. Here, Bose has a policy of not licensing its technology, and it has not licensed the '721 patent. Both parties agreed that this factor would weigh in favor of a higher royalty rate.

v. Commercial relationship between the parties. Bose and JBL, by all accounts, are direct competitors in the marketplace. Both parties agreed that this factor would weigh in favor of a higher royalty rate.

vi. Effect on and extent of derivative or convoyed sales. Mr. Coley testified that, in his experience, purchasers of the Lifestyle systems tend to purchase add-on systems, or systems for additional rooms. Moreover, he testified that consumers purchasing speaker systems would also be inclined to purchase amplifiers or receivers by the same company; in this case, then, JBL might enjoy additional derivative sales alongside sales of its speakers systems incorporating the patented technology. JBL argues that Mr. Coley could not quantify or document this phenomena. Overall, while I find Mr. Coley generally credible, he was a bit too enthusiastic on this issue. The evidence on this factor was anecdotal. I find that this factor is neutral in its effect on a royalty rate.

vii. Duration and term of license. The '721 patent issued on February 3, 1998 and has a term of 11 years. Mr. Barry argued that this weighed in favor of a higher royalty rate; Mr. Keller considers this to be a neutral factor because the amount of time left on the patent is "average." However, since over half of the patent was left to run, I consider this to weigh in favor of a higher royalty rate, though not strongly so.

viii. Established profitability of the product made under the patent, its commercial success, and popularity. Mr. Barry testified that Bose and JBL collectively have made approximately $400 million in sales of products incorporating the invention, and enjoyed roughly 20% profit margins on some products. Although JBL argued that the '721 patent covers only the port tube and speaker enclosure, and that the commercial success of the products cannot reasonably be attributed to the port design, I have already found that the port design substantially contributed to the demand for, and success of, the products. I find that this factor weighs in favor of a higher royalty rate.

ix. Utility and advantages of the patented article over old modes. By all accounts, the elliptical port design incorporated in the '721 patent exhibits substantial advantages over earlier port designs. Both parties agree that this factor weighs in favor of a higher royalty rate.

x. Nature of patented invention; character of commercial embodiment of the patent as owned or produced by the licensor. Bose uses the elliptically flared port tubes in many of its products. Both parties agree that this factor weighs in favor of a higher royalty rate.

xi. Extent to which infringer has made use of invention. Both parties agree that, since JBL has used the elliptical port tube in several of its products, this factor also weighs in favor of a higher royalty rate.

xii. Portion of profit or selling price customarily allowed. Both parties agreed that this was a neutral factor, since there are no licenses on the port

tube technology. Mr. Barry could find no comparable licenses in the field of acoustics.[18]

xiii. Portion of realizable profit attributable to invention. Because the products in question encompass more than just the invention, Bose conceded that this factor would tend to lead to a lower royalty rate.

xiv. The opinion testimony of qualified experts. In essence, there were few areas of dispute between Mr. Barry and Mr. Keller as to the *Georgia-Pacific* factors. Both concluded that the *Georgia-Pacific* analysis would justify a 4% "up-tick" in the royalty rate, but Mr. Keller insisted that the starting point of the negotiation would be zero, while Mr. Barry opined that a starting point would be 5%.

xv. The amount a willing licensor and licensee would agree upon at the time of infringement, had both been reasonably and voluntarily trying to reach agreement, including the amount of profit the licensee would be willing to contribute to the license. Neither party offered evidence of a comparable licensing negotiation related to any comparable patent. When pressed to offer comparable royalty rates in the industry, Mr. Barry referred to a survey in a licensing journal which, according to his recollection, stated that 5 to 10 percent was the average range in the consumer electronics area.

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[18] JBL introduced evidence regarding the licensing practices of Dolby Digital Electronics, a company that commonly licenses its "surround sound" decoding technology and "signal noise reduction" technology to various loudspeaker companies. JBL attempted to make much of the fact that Dolby's license rates are approximately 50 cents, or less, per unit. However, Dolby does not manufacture speakers, is not a competitor to the speaker companies themselves, and essentially makes its business by licensing its technology. For these reasons, I find that the Dolby licensing practices and rates are not comparable for purposes of a royalty analysis here.

The Baseline Rate. The main area of dispute between Mr. Barry and Mr. Keller was whether the starting point for a reasonable royalty rate was zero, or some other baseline royalty rate. I find Mr. Keller's position, that the baseline is zero, to be unrealistic and contrary to the available case law on the subject. *See Standard Mfg.*, 42 Fed. Cl. at 764 (finding that, in determining a reasonable royalty rate, "it is also prudent to initially establish a reference, or 'baseline' royalty rate" which can be adjusted upward or downward depending on the *Georgia-Pacific* factors). Courts have found the 25%/75% approach to be a useful approach to arriving at a baseline royalty rate. *See id.* at 766. While there is no requirement to use a 25%/75% approach, Mr. Keller conceded that this approach is a common and reasonable one, though he has never used that approach in negotiating licenses. He also stated that, if he were to consider the 25%/75% approach, it would properly be considered as part of the fifteenth *Georgia-Pacific* factor.

Mr. Barry arrived at a 5% baseline rate by using the "25%/75%" rule-of-thumb, which allocates 25% of the profits on the product incorporating the patent to the patentee and 75% of the profits to the licensee. Mr. Barry calculated a 21% profit margin for JBL by taking the total sales of infringing products and subtracting both the product costs as well as JBL's selling, general and administrative expenses. Mr. Barry excluded the two infringing JBL products that were experiencing a negative profit, reasoning that, in a hypothetical royalty negotiation at the time infringement began, JBL would likely have opted to discontinue manufacturing those products in the face of losses.

To complicate matters further, JBL offered the testimony of Chester Simon, Senior Vice President for the

Harmon Consumer Group.[19] Mr. Simon refuted Mr. Barry's profit margin calculations on the accused products. For example, Mr. Simon testified that the MUSIC 10, MUSIC 20, and Festival 80 products actually experienced a negative profit over the first year and a half of the infringement period.

However, effective cross-examination exposed several flaws with the accounting proffered by Mr. Simon. In accounting for "tooling" costs for the accused products, Mr. Simon relied upon estimates provided by his product development personnel; no records were available. But more importantly, Simon took the entire tooling cost of the products, over the entire period they were offered for sale, and offset it against the net sales for a one and a half year period. In the case of the MUSIC 10 and MUSIC 20, this resulted in a total of $1 million in tooling costs being set against modest sales totals for each product from February of 1998 through December of 1999. In the case of the Festival 80, approximately $3 million in tooling costs were set against approximately $1.9 million in sales. Mr. Simon conceded that the huge losses he calculated on the Festival 80 were responsible for producing a negative gross profit for all the accused products for the period he considered. Mr. Simon's approach shrinks JBL's profit margins for the accused products during the infringement period, but I find it was unreliable.

c. *Reasonable Royalties.*

On the basis of admittedly imperfect information, I find that a 7% royalty rate should be applied. First, I find that some baseline rate higher than zero would frame negotiation discussions. Second, seven of the applicable

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[19] Harmon Consumer Group is a division of Harmon, International Corp., the parent corporation which includes JBL, Infinity, and Harmon Kardon.

Georgia-Pacific factors weigh in favor of a higher royalty rate, while only two weigh in favor of a downward adjustment in the rate. Third, JBL did not refute Mr. Barry's testimony that a range of 5-10% was typical in the consumer electronics field. Fourth, whether one considers the profit margin evidence as part of the *Georgia-Pacific* analysis or in determining a baseline rate, I find that JBL enjoyed substantial profit margins on the majority of the infringing products. The accounting glitches in Mr. Simon's analysis eviscerate his calculations; however, Mr. Barry's disregard of the poorly performing ESC 550 and Festival 80 artificially inflates the average profit margin.

Using the exhibits prepared by Mr. Barry, I adopt his numbers representing JBL's sales of the infringing products over the infringement period.[20] However, largely because of factor eight of the *Georgia- Pacific* analysis, I multiply the total sales by 7%, rather than Bose's proposed 9%.

3. Damages Totals

Reasonable Royalty

Product	***Total JBL Sales***	***Royalty Due*** (Sales × 7%)
Music 10	$ 974,850	$ 68,239.50
Music 20	$ 531,143	$ 37,180.01
ESC 300	$ 2,820,052	$ 197,403.64
SCS 110	$ 1,491,476	$ 104,403.32

[20] JBL objects to Mr. Barry's inclusion of foreign sales in his calculation of JBL's total sales during the infringement period. Mr. Barry testified that he included foreign sales of products that were either made in the United States or warehoused here for some period of time. JBL neither developed this argument, nor cited any cases to support its position that such sales should not be included in a damages calculation. The Court found no clear precedent that precludes such foreign sales. The argument is waived.

SCS 115	$ 716,512	$ 50,148.84
SCS 120	$ 2,053,799	$ 143,765.93
SVACENTER	$ 680,126	$ 47,608.82
SVA 1500	$ 350,275	$ 24,519.25
F80Sub/230	$ 406,329	$ 28,443.03
S50	$ 114,172	$ 7,992.04
NSP1	$ 762,510	$ 53,375.70
N-CENTER	$ 767,188	$ 53,703.16
ND310	$ 1,512,274	$ 105,859.18
N24	$ 1,035,062	$ 72,454.34
N26	$ 1,063,155	$ 74,420.85
N28	$ 743,560	$ 52,049.20
N38	$ 1,024,124	$ 71,688.68
S-CENTER	$ 1,013,703	$ 70,959.21
S310	$ 482,111	$ 33,747.77
S312	$ 1,537,213	$ 107,604.91
S38	$ 1,716,908	$ 120,183.56
S26	$ 431,428	$ 30,199.96
PSW-D110	$ 5,926,341	$ 414,843.87
PSW-D112	$ 2,925,403	$ 204,778.21
PSW-D115	$ 909,690	$ 63,678.30
ESC 300"B"	$ 491,604	$ 34,412.28
ESC 333	$ 433,083	$ 30,315.81
ESC 350	$ 1,372,290	$ 96,060.30
ESC 550	$ 4,259,641	$ 298,174.87
SCS 125	$ 11,472,131	$ 803,049.17
TLX271P	$ 1,008,800	$ 70,616.00
RS10	$ 822,550	$ 57,578.50
RS8	$ 1,527,517	$ 106,926.19
HPS-250	$ 543,010	$ 38,010.70
HPS-500	$ 163,565	$ 11,449.55
TOTAL:	**$ 54,083,495**	**$ 3,785,844.65**

Festival 80: Lost Profits and Reasonable Royalty

Here, the Court first determines lost profits on sales that Bose would have made but for the infringing Festival 80. The evidence is that Bose had 100% of the market

share in the OBSS price band ($1,000--$2,000) which included Festival 80. The Court then must calculate the reasonable royalty on the remaining foreign sales. These calculations follow.

Product	*Lost Profits* (A)	*Sales Covered Under Reasonable Royalty* (B)	*Reasonable Royalty* (B x .07)	*Total Damages* (A + B)
Festival 80	$1,889,188	$24,081	$1,685.67	$1,890,873.67

Total damages amount to **$5,676,718.32.**

4. Attorney's Fees/Multiple Damages

I decline to award attorney's fees or multiple damages.

Under 35 U.S.C. § 285, "[t]he court in exceptional cases may award reasonable attorney fees to the prevailing party" in patent infringement litigation. *See Hoffmann-La Roche, Inc. v. Invamed, Inc.*, 213 F.3d 1359, 1365 (Fed. Cir. 2000). "Among the types of conduct which can form a basis for finding a case exceptional are willful infringement, inequitable conduct before the P.T.O., misconduct during litigation, vexatious or unjustified litigation, and frivolous suit. Such conduct must be supported by clear and convincing evidence." *Beckman Instruments, Inc. v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989) (citations omitted).

For the reasons outlined above in the discussion of willfulness, I find that Bose has not proven that JBL engaged in fraud, inequitable conduct, or acted in bad faith during the course of the litigation. On the same basis, I decline to award multiple damages under 35 U.S.C. § 284.

5. Pre-Judgment Interest/Costs

Under 35 U.S.C. § 284, a court awards the successful claimant "damages adequate to compensate for the infringement ... together with interest and costs as fixed by the court." The Supreme Court has held that prejudgment interest should ordinarily be rewarded, as it is a piece of the compensation due to the patent owner. *See General Motors Corp. v. Devex Corp.*, 461 U.S. 648, 655, 103 S.Ct. 2058, 76 L.Ed.2d 211 (1983). Prejudgment interest runs from the date of infringement to the date of judgment, *see Nickson Indus. v. Rol Mfg. Co.*, 847 F.2d 795, 800 (Fed. Cir. 1988) and applies to both the award of lost profits damages as well as reasonable royalty damages. *See Gyromat Corp. v. Champion Spark Plug Co.*, 735 F.2d 549, 556 (Fed. Cir. 1984).

Bose has proposed that prejudgment interest be calculated using the three- month Treasury Bill rate, with interest compounded annually. The Federal Circuit approved of this rate as a "benchmark as the shortest term, risk-free investment available to ordinary investors" and found it a proper basis upon which to compensate a patent owner. *Allen Archery, Inc. v. Browning Mfg. Co.*, 898 F.2d 787, 789 (Fed. Cir. 1990). JBL has not opposed the imposition of prejudgment interest or briefed the trigger date.

I find that Bose is entitled to prejudgment interest on its lost profits and reasonable royalties damages at the three-month U.S. Treasury Bill rate, and compounded annually. The interest shall be computed from February 3, 1998 through entry of an Order of Judgment.

The Court further awards taxable costs in favor of Bose.

6. Injunctive Relief

Entry of a permanent injunction is usually granted following a finding of infringement. *See W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 842 F.2d 1275, 1281 (Fed. Cir. 1988). Accordingly, a permanent injunction will issue against the defendants for any further manufacture or sale of products infringing the '721 patent.

7. Inventory

Plaintiff also seeks a reasonable royalty on whatever infringing products the defendant may still have in its inventory. The defendant has not objected, and it is unclear whether such products in fact exist. However, Plaintiff has not cited any authority supporting a damages award based on unsold inventory. While it is true that infringement stems from the manufacture, use, or sale of a patented invention, *see* 35 U.S.C. § 271, the parties have not briefed the Court on the proper application of this provision vis-a-vis a damages award stemming from unsold goods. Although some courts have issued injunctions ordering the destruction of remaining infringing inventory, *see Beckman Instruments*, 892 F.2d at 1549, this remedy seems extraordinarily wasteful. Perhaps the parties could reach an agreement to donate any remaining infringing speakers to charities, such as schools or shelters, so that the less well- heeled segments of society might enjoy the bass sounds of Madonna's "Erotica" free of port noise.

III. ORDER

I ***ORDER*** judgment for the plaintiff, in the amount of $5,676,718.32, plus prejudgment interest and costs. I ***ORDER*** that a permanent injunction issue, enjoining any further production or sale of products infringing the ' 721 patent.

Within 10 days of entry of judgment, defendant shall account to plaintiff each infringing product sold from April, 2000 through judgment and its sale price. Within ten days thereafter, plaintiff shall submit its calculation of damages (without prejudgment interest) for those infringing sales, according to the scheme laid out above. The Court shall then compensate Plaintiff for those sales.

/s/

Patti B. Saris
United States District Judge

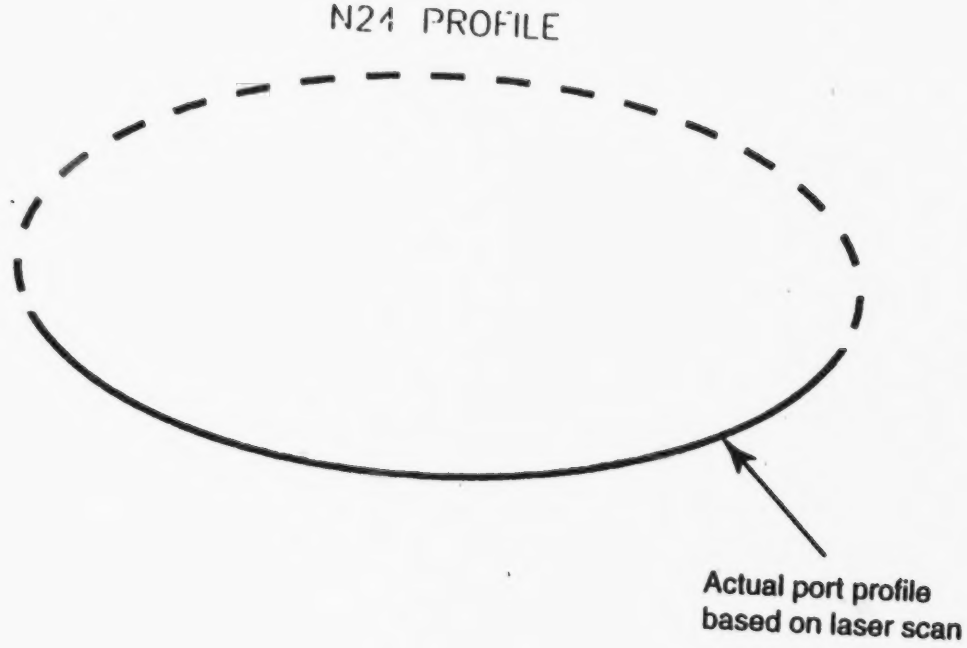

EXHIBIT 111

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

BOSE CORPORATION *Plaintiff,* v. JBL, INC., And INFINITY SYSTEMS CORPORATION, *Defendants.*	Civ. No. 98-10209 DISTRICT JUDGE PATTI B. SARIS
JBL, INC., And INFINITY SYSTEMS CORPORATION, *Counter-Claimants,* v. BOSE CORPORATION, *Counterclaim Defendant.*	

MEMORANDUM AND ORDER

April 14, 2000

SARIS, U.S.D.J.

INTRODUCTION

This is a patent infringement suit between two companies that design and manufacture audio loudspeakers. Plaintiff Bose Corporation ("Bose") claims that defendant JBL, Inc. ("JBL") infringed U.S. Patent No. 5,714,721, entitled "PORTING" ("the '721 patent") which relates to a loudspeaker enclosure with a port for radiating acoustic energy from a region inside the enclosure to a region outside the enclosure at high sound levels without audible "port noise." The design of the port tube is critical to eliminating this audible "port noise."

The specific feature at issue here is the shape of the boundary surrounding the port tube. The '721 patent contains a claim limitation which defines this boundary as "an ellipse having a major diameter." The JBL speakers that are the subject of JBL's motion for summary judgment of non-infringement[1] contain boundaries defined by curves that are not exact mathematical ellipses.

Bose claims that JBL has infringed the '721 patent by making and selling speaker enclosures covered by the patent claims. JBL counterclaims, seeking a declaration that Bose's patent is invalid and that JBL has not infringed. JBL argues that since the curves defining its port boundaries are not ellipses, there is no literal infringement. Furthermore, JBL argues that Bose is estopped to assert infringement by equivalents, as applied to JBL's accused models, because amendments and cancellations Bose made during prosecution of the patent application give rise to prosecution history estoppel. JBL moves for summary judgment of non-infringement. Bose opposes JBL's motion, and moves for summary judgment that claim 1 of the '721 patent covers JBL's loudspeaker enclosures. Bose's motion includes both the models subject to JBL's motion for summary judgment of non-infringement, as well as several other models which JBL has admitted have boundaries defined by an ellipse.[2]

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[1] The speaker models that are the subject of JBL's motion for summary judgment of non-infringement are: N24; N26; N28; N38; ND310; S26; S38; S312; SCS125; ESC300B and ESC350.

[2] JBL has conceded that the following models have port tube boundaries defined by an ellipse: MUSIC 10, MUSIC 15, MUSIC 20, SCS 110, SCS 115, SCS 116, SCS 120, ESC 550, SPK 550, Bass 10, Bass 15, Bass 16, Bass 20, Festival 80, Bass 550, SVA 1500, SVACENTER, S50, ESC300, and SUB300. As to these models, JBL still argues its affirmative defense of invalidity.

For the reasons stated below, I ***ALLOW*** JBL's motion for summary judgment of non-infringement, to the extent it seeks a declaration that the JBL speaker models that are not mathematical ellipses do not *literally* infringe the '721 patent. I ***DENY*** JBL's motion seeking a declaration that JBL's models do not infringe under the doctrine of equivalents. I ***ALLOW*** Bose's motion for summary judgment as to the speaker models which JBL has admitted contain port tube boundaries defined by ellipses. I ***DENY*** Bose's motion as to the models in dispute in JBL's motion for summary judgment of non-infringement.

BACKGROUND FACTS

The following facts are undisputed, unless otherwise noted.

A. Prosecution History of the '721 Patent

On December 3, 1990, Bose filed a patent application, Serial No. 621,531, seeking protection for a speaker enclosure with multiple subchambers and passive radiators. This application ultimately issued on March 3, 1992 as U.S. Patent No. 5,092,424 to Schreiber et al. (the "Schreiber patent"). On February 27, 1992, prior to issuance of the Schreiber patent, Bose filed a "continuation-in-part," ("C-I-P"), Serial No. 843,858, of the Schreiber application related to porting in a loudspeaker system. In this C-I-P application, claim 1 was not limited to an elliptical port. Claim 1 read as follows:

> A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume.

Claim 2 of the C-I-P application was dependent upon claim 1 and added the limitation, "wherein said port defines a boundary between the acoustic mass therein and said inside volume, said boundary being defined by an ellipse." Claim 3 was made dependent upon claim 2, and added the limitation, "wherein the length of said port corresponds to the major diameter of said ellipse."

The Patent and Trademark Office ("PTO") Examiner rejected the originally filed claim 1 under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 3,142,353, issued to Todisco ("Todisco") or U.S. Patent No. 4,213,515, issued to Laupman ("Laupman"). The Examiner stated that claims 2 through 4, relating to an elliptical port, would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims.

Bose then amended claim 1, and added the limitation "wherein said at least one port has a lengthwise axis, said at least one port being symmetrical about said lengthwise axis, the entire perimeter of both said input and said output end being smoothly flared." (Amendment A). The Examiner again rejected the amended claim as anticipated by Todisco or Laupman.[3] Bose unsuccessfully appealed the Examiner's rejection, then amended claim 1 again to "clarify that both the input and output end are smoothly flared." (Amendment C). The Examiner then rejected claim 1 under 35 U.S.C. § 102(e) as anticipated by a newly found prior art patent, U.S. Patent No. 5,109,422, issued

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[3] The rejection based on Laupman was eventually reversed by the Board of Patent Appeals and Interferences on the grounds that the two ends of Laupman could not be "flared" because they "terminate at a completely straight side of the member." (See Katz Decl., Exh. B)

to Furukawa ("Furukawa"). The Examiner found that Furukawa disclosed the following:

> [a] loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said volume and a smoothly flared output end adjacent to the region outside said inside volume, wherein said at least one port has a lengthwise axis ... said at least one port being symmetrical about said lengthwise axis, [and] the entire perimeter of both said input end and said output end being smoothly flared.

In addition, Furukawa disclosed each of the ports having a "circular cross section" and one port which is "symmetrical about a plane perpendicular to said lengthwise axis midway between said input end and said output end."

Bose then amended claim 1 to add the following limitation:

> with the cross-sectional area of said at least one port progressively decreasing from both said input end and said output end toward the center of said at least one port for substantially the distance between said input end and said center and substantially the distance between said output end and said center.

(Amendment D). Bose argued to the Examiner:

> While the embodiments disclosed in this application have this progressively decreasing cross-sectional area substantially all the way from each end to the center, one ought not to be able to escape infringement by flattening a short length of the center portion.

The Examiner rejected claim 1 on three separate grounds. First, the Examiner rejected claim 1 under 35 U.S.C. § 132 because it introduced "new matter" into the specification. The Examiner stated:

> The added material which is not supported by the original disclosure is as follows: "Both flared port tube P3 and flared port conduit 21 have a cross-sectional area progressively decreasing from each end toward the center for *substantially* the distance between each end and the center." This is deemed to be new matter because the originally filed specification fails to describe the "port tube P3" in the manner set forth in this amendment. Moreover, this amendment directly contradicts the "port tube P3" illustrated in Figure 1. Therein, the "port tube P3" is shown with "a toroid of elliptical cross section" without any deviation therefrom.

The Examiner also rejected amended claim 1 under 35 U.S.C. § 112 because the term "substantially" rendered the claim indefinite; that is, it did not "enable one skilled in the art to reasonably establish what may be construed as being within the metes and bounds of the term of degree." Finally, the Examiner rejected amended claim 1 under 35 U.S.C. § 102(e), stating that the "newly added limitation to claim 1 fails to distinguish the claimed invention from the disclosure of Furukawa since the cross-sectional area of the port of Furukawa 'progressively decreas[es] from each end toward the center for *substantially* the distance between each end and the center.' "

Bose made two additional sets of amendments to claim 1. In the first set, Bose substituted the phrase "a minimum inside" for "the center of"; the term "minimum" for "center"; and the phrase "the entire distance" for "the distance." (Amendment E). Finally, Bose substituted "a

plane of minimum cross-section area inside" and "plane of minimum cross-sectional area" for "a minimum inside" and "minimum." (Amendment F). The Examiner rejected both of these amended claims on the same grounds as he rejected Amendment D: new matter; indefiniteness; and prior art. A summary of each iteration of claim 1 is attached hereto as Exhibit A.

Bose ultimately cancelled the originally filed claim 1 as amended. Bose then rewrote claim 2 as independent claim 1, and rewrote the remaining claims to depend upon claim 1. The Examiner required Bose to add the phrase "having a major diameter" to claim 1 to provide antecedent basis for the reference to the term in claim 3, as issued. On September 9, 1997, the Examiner allowed the pending claims. Claim 1, the only independent claim of the '721 patent, issued as follows:

> 1. A loudspeaker enclosure with at least one port for radiating acoustic energy to a region outside said enclosure and having an inside volume,
>
> said at least one port having an axis and characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said input volume and a smoothly flared output end adjacent to the region outside said volume,
>
> wherein said port defines a boundary between the acoustic mass therein and said inside volume,
>
> said boundary being defined by an ellipse having a major diameter.

B. The JBL Port Tube Boundaries

The JBL port tubes that are the subject of its motion for summary judgment for non-infringement have one of

two curves, the LinearA curve and the Exponential curve, that define the boundary that divides the acoustic mass from the inside volume. The formulas for these curves vary from the mathematical formula for an ellipse. Accordingly, neither of JBL's curves has a major diameter, which is the longest straight line segment joining two points on the curve of an ellipse. As used in the port tubes, however, JBL's curves are substantially elliptical. Finally, regardless of which party's graphs, sketches or laser scans one consults, JBL's port tubes are continuously curved and thus (unlike the Furukawa tubes) have a continuously decreasing cross-section.

DISCUSSION

Summary judgment is proper if "the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to judgment as a matter of law." Fed.R.Civ.P. 56(c). Summary judgment is improper "if the evidence is such that a reasonable jury could return a verdict for the nonmoving party." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248, 106 S.Ct. 2505, 91 L.Ed.2d 202 (1986).

A. Literal Infringement

"Determining whether a patent has been infringed involves two steps: (1) claim construction to determine the scope of the claims, followed by (2) determination whether the properly construed claim encompasses the accused structure." *Bai v. L & L Wings, Inc.*, 160 F.3d 1350, 1353 (Fed. Cir. 1998). An accused device may infringe in one of two ways: literally, or under the doctrine of equivalents. "Literal infringement requires that the accused device contain each limitation of the claim exactly; any deviation from the claim precludes a finding of literal infringement." *Litton Sys., Inc. v. Honeywell, Inc.*, 140 F.3d 1449, 1454

(Fed. Cir. 1998). Summary judgment is proper as to issues of literal infringement, then, where "no reasonable jury could find that every limitation recited in the properly construed claim either is or is not found in the accused device." *Bai*, 160 F.3d at 1353.

The question of literal infringement in this case turns on the interpretation of the phrase, "said boundary being defined by an ellipse having a major diameter" contained in claim 1 of the '721 patent. Bose claims that the correct interpretation of the phrase encompasses port boundaries that are an "elongated circle" or "oval." JBL contends that "ellipse having a major diameter" has a single plain meaning: an ellipse is a well-known geometric shape with a precise mathematical definition. I agree with JBL.

To construe a claim, courts principally consult evidence intrinsic to the patent, including the claims themselves, the specifications, and the prosecution history. *See Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582-83 (Fed. Cir. 1996). Looking first to the claim language, "words in a claim are generally given their ordinary and customary meaning," and if a patentee wishes to use a special definition of a term, that special definition must be clearly stated in the patent specification or prosecution history. *Id.* at 1582. Bose did not do so here.

Looking to the claim term itself, I find that the term "ellipse having a major diameter" unambiguously connotes the geometric definition of "ellipse", a shape defined by the formula:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

where "a" and "b" are constants. The inclusion of the phrase "having a major diameter" invokes the very

"mathematically precise" meaning that Bose now wishes to disavow. A "major diameter," as stated above, is the longest chord, or straight line segment, joining two points on a curve. The major diameter passes through the center of an ellipse.

The prosecution history supports this narrow interpretation of the phrase "ellipse having a major diameter." Bose amended claim 1 several times, and, at least in response to its last three amendments (Amendments D through F), the Examiner rejected proposed claims which would have been elliptical, broadly speaking, but which left room for a short, flattened section. In Amendment D, for example, Bose sought coverage for a port tube with "cross-sectional area progressively decreasing from each end toward the center for *substantially* the distance between each end and the center."

Bose offers alternative dictionary definitions of the term "ellipse" as meaning an "oval" or "elongated circle," as well as the affidavit of its electroacoustical engineer, Michael O'Connell, who asserts that "ellipse" is understood by O'Connell and those skilled in the art of speaker design to mean "an elongated circle or symmetrical oval, a portion of which corresponds to a section along the length of the continuously curved inside surface of the port that is of tapered cross section...." As a threshold matter, courts may not look to extrinsic evidence to construe a claim term unless the intrinsic evidence is ambiguous or insufficient. *See Bell & Howell Document Management Prods. Co. v. Altek Sys.*, 132 F.3d 701, 706 (Fed. Cir. 1997). Here, I find that the intrinsic evidence is sufficient to properly construe claim 1.

But even assuming that some ambiguity arose in the intrinsic evidence, Bose's proposed constructions fail on their own terms as well. As to the "oval" definition, the

dictionary discloses definitions for "oval" which range from "a racetrack in the shape of an oval or a rectangle having rounded corners" to "having the shape of an egg ... broadly elliptical." *Merriam Webster's Collegiate Dictionary* 827 (10th ed.1993). The former definition of "oval" stands in contrast to Bose's repeated insistence that its port tube boundary is continuously curved. In fact, this is the basis upon which Bose distinguished the Furukawa prior art.

Both of the dictionary "oval" definitions are so broad that they would eviscerate the "having a major diameter" qualification in claim 1. The "major diameter" language undercuts Bose's argument that "ellipse" should not be confined, at least for literal infringement purposes, by its geometric definition. *See Vitronics*, 90 F.3d at 1584 n.6 (approving the use of dictionaries in construing claim terms, so long as dictionary definitions do not contradict meanings ascertained by reading the patent documents); *Bai v. L & L Wings, Inc.*, No. 95-10824, 1997 WL 527870, at *2 (S.D.N.Y.1997) (finding that geometric definition found in dictionary was in accord with patent specifications, and concluding that "hemisphere" meant "less than a sphere, but nevertheless part of a sphere"), *aff'd*, 160 F.3d 1350 (Fed. Cir. 1998).

Finally, the "elongated circle" definition Bose proposes actually bolsters JBL's argument. JBL's expert Professor Robert Greene provides the following definition:

> An ellipsis is, by definition, a closed plane curve generated by a point moving such that the sum of its distances to two fixed points (called "foci") is a constant (larger than the distance between the two fixed points). This definition is also *exactly* equivalent, however, to another characterization that is easier to understand intuitively and easier to check in practice. Namely, an ellipse is the curve obtained by enlarging a circle in one direction

> while leaving it unchanged in the perpendicular direction.

(emphasis added). Thus, an "elongated circle" is equivalent to an ellipse.

Having thus construed claim 1, I conclude that no reasonable jury could find that the JBL accused port tubes with LinearA and Exponential curves literally infringe the '721 patent. The literal infringement analysis here is straightforward: the port tube boundaries in JBL's accused products are not defined by ellipses with major diameters, but rather by the LinearA and Exponential curves. Since claim 1 of the '721 patent specifies that the port tube boundary of Bose's invention is "an ellipse having a major diameter," JBL's eleven disputed models do not literally infringe.[4]

B. Doctrine of Equivalents

An accused device that does not infringe literally may still infringe under the doctrine of equivalents, if the patent holder shows that the accused device performs substantially the same function, in substantially the same way, to produce substantially the same result as the claimed invention. *See Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 608, 70 S.Ct. 854, 94 L.Ed. 1097 (1950). Moreover, "the doctrine of equivalents must be applied to individual elements of the claim, not to the invention as a whole." *Litton*, 140 F.3d at 1454 (quoting *Warner-Jenkinson v. Hilton Davis Chem. Co.*, 520 U.S. 17, 29, 117 S.Ct. 1040, 1049, 137 L.Ed.2d 146 (1997)). "An analysis of the role played by each element in the context

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[4] Of course, the JBL models that admittedly have port tube boundaries defined by an ellipse do literally infringe the '721 patent, since those port tubes also contain every other limitation of claim 1 of the '721 patent. As to these models, JBL relies upon successfully proving its affirmative defense of invalidity to avoid liability.

of the specific patent claim will thus inform the inquiry as to whether a substitute element matches the function, way and result of the claimed element, or whether the substitute element plays a role substantially different from the claimed element." *Warner-Jenkinson,* 520 U.S. at 29, 117 S.Ct. 1040.

Summary judgment is properly rendered on a claim of infringement under the doctrine of equivalents where "the evidence is such that no reasonable jury could determine two elements to be equivalent." *Bai,* 160 F.3d at 1353-54 (quoting *Warner-Jenkinson,* 520 U.S. at 39 n. 8, 117 S.Ct. 1040). Moreover, "if prosecution history estoppel would apply or if a theory of equivalence would entirely vitiate a particular claim element, partial or complete summary judgment should be rendered by the court, as there would be no further material issue for the jury to resolve." *Id.* at 1354 (quoting *Warner-Jenkinson,* 520 U.S. at 39 n. 8, 117 S.Ct. 1040). Whether prosecution history estoppel applies is a question of law. *See La Bounty Mfg., Inc. v. United States Int'l Trade Comm'n,* 867 F.2d 1572, 1576 (Fed. Cir. 1989).

1. Prosecution History Estoppel

JBL contends that any claim of infringement under the doctrine of equivalents is barred by the application of prosecution history estoppel. Specifically, JBL argues that Bose's multiple amendments of the original claim 1, and its eventual abandonment of that broader claim, bar Bose from recapturing through litigation patent protection for port tube boundaries other than those defined by "an ellipse having a major diameter." Alternatively, JBL argues that the prior art restricts the scope of the doctrine of equivalents, and urges the Court to engage in a "hypothetical claim analysis."

Bose responds that, looking to the reasons it amended claim 1, Bose did not surrender subject matter that would

include JBL's LinearA and Exponential curved port tubes, but rather amended the claim to distinguish its port boundary from a more flattened cylindrical boundary in the prior art Furukawa patent. Accordingly, Bose argues that prosecution history estoppel does not arise. Bose also contends that since the originally filed claim 1 had nothing to do with an ellipse, the eventual cancellation of that broader claim is irrelevant to this case. Although the application of prosecution history estoppel requires interpretation of a truly elliptical area of the law, I conclude that Bose's position is the better supported one.

The doctrine of prosecution history estoppel "bars a patentee from construing its claims in a way that would resurrect subject matter previously surrendered during prosecution of the patent," and thus, under certain circumstances, "prevents a patentee from enforcing its claims against otherwise legally equivalent structures." *Mannesmann Demag Corp. v. Engineered Metal Prods. Co.*, 793 F.2d 1279, 1284-85 (Fed. Cir. 1986) (invoking estoppel where plaintiff's "enlarged claim interpretation ... falls squarely within the claim scope [plaintiff] relinquished in order to overcome the cited references"). The "surrender" of subject matter can come about via amendments to a claim to avoid prior art. It can also arise where, as here, a broad independent claim is cancelled, and dependent, narrower claims are rewritten in independent form and ultimately allowed. *See Haynes Int'l, Inc. v. Jessop Steel Co.*, 8 F.3d 1573, 1578-79 (Fed. Cir. 1993), *clarified*, 15 F.3d 1076 (Fed. Cir. 1994) (upholding application of prosecution history estoppel where the cancelled claim upon which the issued claim originally depended contained a range of chromium contents broad enough to encompass the defendant's product, and where the "chromium content was the principal distinction between the claimed subject matter and the prior art"); *Diversitech Corp. v. Century Steps,*

Inc., 850 F.2d 675, 681 (Fed. Cir. 1988) (finding estoppel where issued claim was initially dependent on a broader claim that was rejected by the PTO and eventually cancelled).

Arguments made during prosecution, without amendments to claim language, may give rise to estoppel if those arguments are "sufficient to evince a clear and unmistakable surrender of subject matter." *Litton*, 140 F.3d at 1458; *see also Texas Instruments, Inc. v. United States Int'l Trade Comm'n*, 988 F.2d 1165, 1174 (Fed. Cir. 1993) (emphasizing that the proper test for estoppel examines the "prosecution history taken as a whole"); *Kinzenbaw v. Deere & Co.*, 741 F.2d 383, 389 (Fed. Cir. 1984).

The key components of a prosecution history estoppel analysis are determining what subject matter was surrendered, *and* the reason that it was surrendered. "The legal standard for determining what subject matter was relinquished is an objective one, measured from the vantage point of what a competitor was reasonably entitled to conclude, from the prosecution history, that the applicant gave up to procure issuance of the patent." *Haynes*, 8 F.3d at 1578. Once the subject matter surrendered is identified, courts look to the reasons behind that surrender. In *Warner-Jenkinson*, the Supreme Court declined to adopt a bright line rule that "any surrender of subject matter during patent prosecution, regardless of the reason for such surrender, precludes recapturing any part of that subject matter, even if it is equivalent to the matter expressly claimed." 520 U.S. at 30, 117 S.Ct. 1040; *see also Hughes Aircraft Co. v. United States*, 140 F.3d 1470, 1476 (Fed. Cir. 1998) (looking to the "reason behind an amendment" to determine what subject matter the patentee was estopped from reclaiming in litigation).

Even amendments made to overcome prior art do not necessarily preclude a range of equivalents. *See Litton*, 140 F.3d at 1456 (stating that "an amendment to claim language in response to prior art 'may have a limiting effect within a spectrum ranging from great to small to zero' ") (quoting *Hughes Aircraft Co. v. United States*, 717 F.2d 1351, 1363 (Fed. Cir. 1983)). Accordingly, "when a rejection based on prior art did not dictate the claim change that was made, it is necessary to look at the specific change and the reason, in ascertaining whether an estoppel has arisen." *Pall Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1219 (Fed. Cir. 1995).

Amendments made to overcome other types of patentability obstacles may or may not give rise to an estoppel, depending on the facts of the case.[5] *See id.* at 1220 (finding, on facts of case, that amendment made to overcome § 112 rejection did not give rise to estoppel); *Sextant Avionique, S.A. v. Analog Devices, Inc.*, 172 F.3d 817, 825 (Fed. Cir. 1999) (declining to decide whether an amendment made in response to a § 112 rejection referring to the requirements of the specification is made for "reasons of patentability" and gives rise to estoppel); *Sun Studs, Inc. v. ATA Equip. Leasing, Inc.*, 872 F.2d 978, 990 (Fed. Cir. 1989) (finding that rejection based on a lack of enablement, which was withdrawn based on the patentee's arguments to the PTO, did not give rise to estoppel); *Moeller v. Ionetics, Inc.*, 794 F.2d 653, 659-60

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[5] On remand from the United States Supreme Court, the Federal Circuit is addressing what types of amendments to a claim give rise to prosecution history estoppel because they stem from a "substantial reason related to patentability." *See Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 187 F.3d 1381, 1381-82 (Fed. Cir. 1999) (quoting *Warner- Jenkinson*, 520 U.S. at 33, 117 S.Ct. 1040) (ordering briefing of several issues presenting interpretive questions under *Warner-Jenkinson*). This turgid area of law is best described as the doctrine of ambivalence.

(Fed. Cir. 1986) (finding, on facts of case, that amendment made to describe the invention more particularly did not give rise to estoppel), *overruled on other grounds by Markman v. Westview Instruments, Inc.*, 52 F.3d 967 (Fed. Cir. 1995).

It is undisputed that over the course of its several amendments to the original claim 1, Bose progressively narrowed its claim language in response to prior art, indefiniteness, and new matter rejections. Bose also made various arguments to support its appeals of these rejections. The Examiner rejected those arguments, and Bose eventually cancelled claim 1. Moreover, the parties do not dispute that JBL's accused devices would fall under the language of claim 1 as originally filed and as amended. Thus, application of prosecution history estoppel here will turn on a close examination of the exchanges between Bose and the PTO to discern the reasons for Bose's surrender of this material.

Bose argues that its amendments to claim 1 were aimed only at distinguishing its port from the Furukawa port, which has a flattened, cylindrical portion of its boundary. Moreover, Bose contends that since neither Bose nor the Examiner ever commented on the meaning of the term "ellipse," as used in originally dependent claim 2, the rewritten claim 2 (which became claim 1 of the '721 patent) covers ports having boundaries defined by an ellipse or its equivalent. Bose argues that the prosecution history of the claim eventually cancelled is irrelevant to this case.

First, under *Haynes*, where an allowed claim was originally dependent upon a broader independent claim which was cancelled, prosecution history estoppel may apply. 8 F.3d at 1579. Despite Bose's position to the contrary, then, the prosecution history of the original claim 1 is highly relevant. However, the language of

Bose's amendments to claim 1, as well as Bose's arguments to the PTO Examiner, show that those amendments were primarily meant to design around the flattened, cylindrical sections of Furukawa. Since JBL's port tubes lack this flattened, cylindrical portion, they are not within the scope of subject matter Bose was forced to surrender to obtain the '721 patent.

Bose made five sets of amendments to the original claim 1, four of which (Amendments C through F) met with rejections based on the prior art Furukawa patent. After each rejection, Bose progressively narrowed its claim to encompass, for example, port boundaries whose cross sections decrease from both the input and output ends for "substantially the distance" between the two ends (Amendment D) or "substantially the entire distance" between the two ends (Amendment E). The Examiner rejected each such iteration, finding the proposed claim language too close to Furukawa. A port tube with flared input and output ends, whose cross sections decrease for "substantially the distance" between the ends, would still leave room for a small flattened portion along the curve.

Bose's arguments to the Examiner similarly show that Bose was trying to develop claim language to avoid the flattened, cylindrical quality of Furukawa's port tubes. For example, in its remarks supporting Amendment D, (*see* Exh. M to Decl. of Marsha Durko at 10), Bose defended its proposed language covering port tubes with "the cross-sectional area progressively decreasing from each end for substantially the distance between each input end and the center." Bose emphasized, however, that "one ought not to be able to escape infringement by flattening a short length of the center portion." This argument was directed at distinguishing Furukawa's longer, cylindrical tube while still trying to obtain patent coverage of a port tube that had a shorter, flattened center portion.

Similarly, in its remarks accompanying Amendment E, (*see* Exh. O to Decl. of Marsha Durko at 14), Bose attempted to convince the Examiner that the Furukawa art lacks a "cross-sectional area progressively decreasing for substantially the entire distance" between both ends, since, in Bose's view, the flattened portions of Furukawa (i.e., those of uniform cross sectional area) are significantly longer than the curved portions (i.e., those of progressively decreasing cross-sectional area). In its remarks accompanying Exhibit F, Bose's focus on avoiding the flattened, cylindrical component of Furukawa is equally clear:

> We have amended claim 1 to call for the progressive decrease from both input end and output end being toward a plane of minimum cross-sectional area ... to make it perfectly clear that the claimed structure excludes the port disclosed in the reference where the internal portion of the port between the flared input and flared output is a cylinder of uniform cross-section that extends for a significant portion of the port length.

(Exh. P to Decl. of Marsha Durko at 12.) In sum, Bose's arguments to the Examiner do not show a "clear and unmistakable surrender" of subject matter encompassing JBL's port tubes.

The accused JBL port tubes do not have a flattened, cylindrical portion; they are, like Bose's port tubes, continuously curved, with a progressively decreasing cross-sectional area. *See Hughes Aircraft,* 140 F.3d at 1477 (finding that prosecution history estoppel applied, but did not preclude all equivalents, where the accused device did not fall into the range of subject matter the patentee surrendered). Therefore, while the prosecution history would preclude Bose from claiming any range of equivalents that contain the flattened section, neither the

prior art nor Bose's arguments during prosecution dictate that Bose be limited to the literal scope of claim 2, and Bose is still entitled to some range of equivalents of an ellipse.

The Examiner's other objections to Bose's original claim 1 do not give rise to estoppel as to JBL's accused port tubes. The Federal Circuit has not squarely addressed whether amendments made in response to "new matter" objections, pursuant to 35 U.S.C. § 132, give rise to prosecution history estoppel. But on the record of this case, I conclude that the new matter objections, and, specifically, the Examiner's mandate that Bose be confined to a "toroid of elliptical cross section, without any deviation therefrom" were made in a similar context as the prior art objections. The Examiner was comparing Bose's proposed language, which would have allowed for a flattened portion of a port boundary, with its original application, which disclosed a continuously curved ellipse.

Turning to the "indefiniteness" objections, the Federal Circuit has declined to adopt a bright-line rule as to whether amendments made to overcome § 112 objections are made for "reasons of patentability" and thus give rise to estoppel. *See Sextant Avionique,* 172 F.3d at 828-29; *Caterpillar Tractor Co. v. Berco,* 714 F.2d 1110, 1115 (Fed. Cir. 1983). On the facts of this case, they do not. The Examiner's indefiniteness objections related to Bose's use of the term "substantially" in Amendments D, E, and F. The prosecution history reveals that these, too, were objections made with the Furukawa port in mind. The Examiner states that the reason "substantially" is problematic is that, if one cannot discern what is "within the metes and bounds of the term," the proposed claim language would once again overlap with the Furukawa prior art. The indefiniteness objections, then, neither add nor subtract from the scope of the prosecution history

estoppel raised by the prior art objections. JBL's port tubes do not fall within that scope.

I conclude that prosecution history estoppel does not apply to preclude Bose from asserting a range of equivalents as to JBL's substantially elliptical port tubes lacking a flattened, cylindrical portion in their center. Whether an accused device infringes under the doctrine of equivalents is a question of fact. *See Bai*, 160 F.3d at 1353. Since a reasonable jury could find that JBL's port tubes meet the 3-part *Graver Tank* test for infringement under the doctrine of equivalents, I deny JBL's motion for summary judgment as to the doctrine of equivalents.

However, since there are disputed issues of fact on this point, I also deny Bose's motion for summary judgment that the JBL LinearA and Exponential port tubes infringe the '721 patent. Bose submitted the affidavit of Michael O'Connell, who states:

> From an acoustic standpoint, ports having boundaries corresponding to the plotted Exponential and LinearA curves are indistinguishable from ports having the boundary of the patent defined by an ellipse and are also indistinguishable from a port having a boundary defined by a mathematically perfect ellipse.

(Decl. of Michael O'Connell dated Nov. 10, 1999 at ¶ 11.) Mr. O'Connell includes graphs comparing the cross sections of the accused JBL tubes with that of an ellipse. One of these graphs is attached as Exhibit B. O'Connell also points out that JBL's own port designer described the JBL ports as elliptical.

In response, JBL has offered the affidavit of Dr. Douglas Button, who concludes based on his tests that the JBL port tubes with the LinearA and Exponential curves reduce port noise in a different way and with a different

result than Bose's elliptical port tubes. Button asserts that the rate at which the diameters of the port tubes decrease has some impact on their performance in eliminating port noise. Although the graph is worth one thousand words, the Button affidavit creates a disputed issue of fact appropriately resolved at trial.

2. Hypothetical Claim Analysis

As an alternative theory supporting its position on non-infringement, JBL urges the Court to engage in "hypothetical claim analysis," and argues that doing so will show that no hypothetical claim which encompasses JBL's port tubes would have been allowable over the prior art.

The doctrine of equivalents cannot be used to protect subject matter in, or obvious in light of, the prior art. *See Athletic Alternatives, Inc. v. Prince Mfg., Inc.*, 73 F.3d 1573, 1582 (Fed. Cir. 1996). Thus, the Federal Circuit limits the doctrine of equivalents to prevent its application if it would ensnare prior art. *See Marquip, Inc. v. Fosber Am., Inc.*, 198 F.3d 1363, 1367 (Fed. Cir. 1999). "Because prior art limits the exclusive right available to an inventor, it also limits the range of permissible equivalents of a claim." *Id.* (citing *Wilson Sporting Goods v. David Geoffrey & Assoc.*, 904 F.2d 677, 684 (Fed. Cir. 1990)).

The Federal Circuit has developed a methodology called "hypothetical claim analysis" to assist courts in determining whether the prior art prevents application of the doctrine of equivalents to a particular claim. *See Marquip*, 198 F.3d at 1367; *Wilson*, 904 F.2d at 684. Under hypothetical claim analysis, the inquiry is twofold. First, the court visualizes a hypothetical patent claim broad enough in scope to literally cover the accused device. Then, the court examines whether the PTO would have allowed that hypothetical claim over the prior art at the

time of invention. *See Marquip*, 198 F.3d at 1367; *Wilson*, 904 F.2d at 684. If the hypothetical claim would have been allowed, then prior art is not a bar to infringement by equivalents; if the claim would not have been allowed, the prior art bars a finding of infringement by equivalents. *See Marquip*, 198 F.3d at 1367. As the court explained in *Wilson*:

> [Hypothetical claim analysis] allows use of traditional patentability rules and permits a more precise analysis than determining whether an accused product (which has no claim limitations on which to focus) would have been obvious in view of the prior art . . . it [also] reminds us that [the patentee] is seeking coverage beyond the limits considered by the PTO examiner.

904 F.2d at 684. Using this approach, the Federal Circuit has precluded infringement under the doctrine of equivalents due to the prior art. *See, e.g., Streamfeeder, LLC v. Sure-Feed Systems, Inc.*, 175 F.3d 974, 981-82 (Fed. Cir. 1999); *Marquip*, 198 F.3d at 1368; *Key Mfg. Group, Inc. v. Microdot, Inc.*, 925 F.2d 1444, 1449 (Fed. Cir. 1991).

JBL argues that any hypothetical claim that would cover JBL's LinearA and Exponential port tubes would not have been patentable over three pieces of prior art that were *not* before the PTO Examiner: the Glastonbury II port; the Akimichi port, and the KEF 104/2 port. JBL urges the Court to use the hypothetical claim language, "said boundary being defined by a smooth, continuous curve" or "said boundary being defined by a substantially elliptical curve." JBL concedes that such hypothetical constructions of claim 1, would encompass JBL's accused tubes, but insists that they would necessarily ensnare the Glastonbury II, Akimichi, and KEF 104/2 prior art. Thus, according to JBL, Bose flunks the hypothetical claim analysis test, and is barred from asserting equivalents.

The problem with JBL's argument is the raw state of the record. Bose vigorously disputes JBL's prior art references (Glastonbury II; Akimichi; and KEF 104/2). First, as to the Glastonbury II port, Bose disputes whether that port qualifies as prior art. It is unclear whether the Glastonbury II tube contains a boundary defined by an ellipse, or even whether, under JBL's "hypothetical claim," the Glastonbury II contains a boundary defined by a "smooth, continuous curve" or a "boundary defined by a substantially elliptical curve". The Glastonbury II contains an adjustable PVC pipe connecting the flared ends of the port. Bose argues, and some documentary evidence suggests, that this adjustable pipe was used to adjust the length of the tube when it was custom-installed into audio speakers. (Exh. C to Decl. of Marsha Durko.) If so, then Glastonbury II, like Furukawa, contained a flattened central portion and would not bar a range of equivalents to claim 1.

As for the Akimichi port, the affidavit of Bose's expert has raised disputed issues as to whether Akimichi reveals a port enclosing an acoustic mass for radiating acoustic energy. This dispute goes to the very function and goal of the two different devices. Moreover, even JBL acknowledges that the Akimichi port is built into the wall of the speaker enclosure; thus, it does not "define a boundary between the acoustic mass therein and said inside volume" as the claim 1 invention does. Whether or not JBL's hypothetical claim language pertaining to the shape of the boundary would encompass Akimichi's boundary shape, then, Akimichi does not meet the other specifications of claim 1.

As to the KEF 104/2, its boundary is continuously curved for a portion, but has a portion that forms a

straight line at an angle with the port axis. As described by Bose's expert:

> [a] portion of the boundary forms a straight line at an angle with the port axis ... [t]his port is not symmetrical about a plane transverse to its axis midway between its ends. The KEF 104/2 reference does not disclose a port boundary that closely resembles an ellipse. The KEF 104/2 reference does not disclose a loudspeaker enclosure of any claim in the '721 patent.

(Decl. of Michael O'Connell dated Jan. 24, 1999 at 2, ¶ 11.)

In sum, the status of the three pieces of prior art to which JBL compares its port tubes is disputed. Further obfuscating the task is the fact that none of these "prior art" references was before the Examiner. Since, on the record now before the Court, it's difficult to know whether I'm comparing apples with apples or apples with oranges, or whether any of JBL's references should inform a hypothetical claim analysis, such an analysis is misplaced.

ORDER

For the forgoing reasons, I ***ALLOW*** in part JBL's motion for summary judgment of non-infringement, to the extent it seeks a declaration that the JBL speaker models with LinearA and Exponential curved port tubes do not *literally* infringe the '721 patent. I ***DENY*** JBL's motion as to whether JBL models with the LinearA and Exponential curved port tubes infringe under the doctrine of equivalents. I ***ALLOW*** in part Bose's motion for summary judgment as to the speaker models which JBL has admitted contain port tube boundaries defined by ellipses (see note 2, above). I ***DENY*** Bose's motion as to the JBL models containing LinearA and Exponential curves.

/s/
Patti B. Saris
United States District Judge

EXHIBIT "A"
Iterations of Claim 1

ORIGINAL CLAIM 1: A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume.
(*Filed February 27, 1992.*)

AMENDMENT A: A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume, wherein said at least one port has a lengthwise axis, said at least one port being symmetrical about said lengthwise axis, the entire perimeter of both said input and said output end being smoothly flared.
(*Amendment A of October 22, 1992.*)

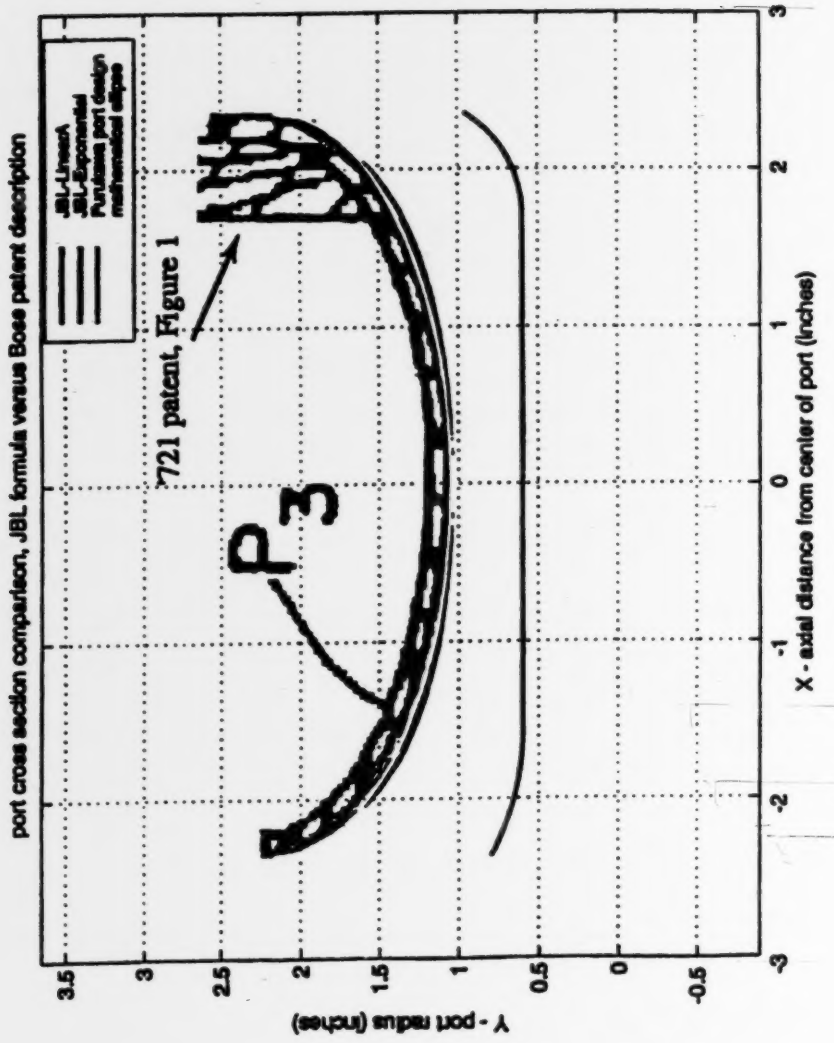
AMENDMENT C: A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume, wherein said at least one port has a lengthwise axis, said at least one port being symmetrical about said lengthwise axis, the entire perimeter of both said input end and said output end being smoothly flared.
(*Amendment C After Decision on Appeal of May 27, 1995.*)

AMENDMENT D: A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume, wherein said at least one port has a lengthwise axis, said at least one port being symmetrical about said lengthwise axis, the entire perimeter of both said input end and said output end being smoothly flared with the cross-sectional area of said at least one port progressively decreasing from both said input end and said output end toward the center of said at least one port for substantially the distance between said input end and said center and substantially the distance between said output end and said center.
(*Amendment D of September 7, 1995.*)

AMENDMENT E: A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume, wherein said at least one port has a lengthwise axis, said at least one port being symmetrical about said lengthwise axis, the entire perimeter of both said input end and said output end being smoothly flared with the cross-sectional area of said at least one port progressively decreasing from both said input end and said output end toward a minimum inside said at least one port for substantially the entire distance between said input end and said minimum and substantially the entire distance between said output end and said minimum.
(*Amendment E of March 14, 1996.*)

AMENDMENT F: A loudspeaker enclosure having an inside volume, and at least one port characterized by predetermined acoustic mass intercoupling said inside volume and the region outside said enclosure having a smoothly flared input end within said inside volume and a smoothly flared output end adjacent to the region outside said inside volume, wherein said at least one port has a lengthwise axis, said at least one port being symmetrical about said lengthwise axis, the entire perimeter of both said input end and said output end being smoothly flared with the cross-sectional area of said at least one port progressively decreasing from both said input end and said output end toward a plane of minimum cross-sectional area inside said at least one port for substantially the entire distance between said input end and said plane of minimum cross-sectional area and substantially the entire distance between said output end and said plane of minimum cross-sectional area. (*Amendment F of October 22, 1996.*)

EXHIBIT 'B'



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In the
United States Court of Appeals
for the Federal Circuit

Appeal No. 01-1054

BOSE CORPORATION,

Plaintiff-Appellee,

v.

JBL, INC. and INFINITY SYSTEMS CORPORATION,

Defendants-Appellants.

Decided January 31, 2002

ORDER

A combined petition for panel rehearing and for rehearing *en banc* having been filed by the APPELLANTS, and the petition for rehearing having been referred to the panel that heard the appeal, and thereafter the petition for rehearing *en banc* having been referred to the circuit judges who are in regular active service,

UPON CONSIDERATION THEREOF, it is

ORDERED that the petition for panel rehearing be, and the same hereby is, DENIED and it is further

ORDERED that the petition for rehearing *en banc* be, and the same hereby is, DENIED.

The mandate of the court will issue on February 7, 2002.

Circuit Judge DYK did not participate in the vote.

FOR THE COURT,

Dated: January 31, 2002 /s/
Jan Horbaly
Clerk

FILED
U.S. COURT OF APPEALS FOR
THE FEDERAL CIRCUIT

JAN 31 2002

JAN HORBALY
CLERK

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

BOSE CORPORATION *Plaintiff,* v. JBL, INC., And INFINITY SYSTEMS CORPORATION, *Defendants.*	Civ. No. 98-10209 DISTRICT JUDGE PATTI B. SARIS
JBL, INC., And INFINITY SYSTEMS CORPORATION, *Counter-Claimants,* v. BOSE CORPORATION, *Counterclaim Defendant.*	

JUDGMENT

September 12, 2000

SARIS, U.S.D.J.

In accordance with the Memorandum and Order dated August 31, 2000, judgment is hereby entered for the plaintiff, Bose Corporation, in the amount of $5,676,718.32.

By the Court:

/s/
Todd M. McGrath
Deputy Clerk